1982 CB ANNUAL REPORT

SUMMARY OF DEVELOPMENT ACTIVITIES, COSTS AND ENVIRONMENTAL MONITORING

CATHEDRAL BLUFFS SHALE OIL COMPANY
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APRIL 30, 1983

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April 30, 1983

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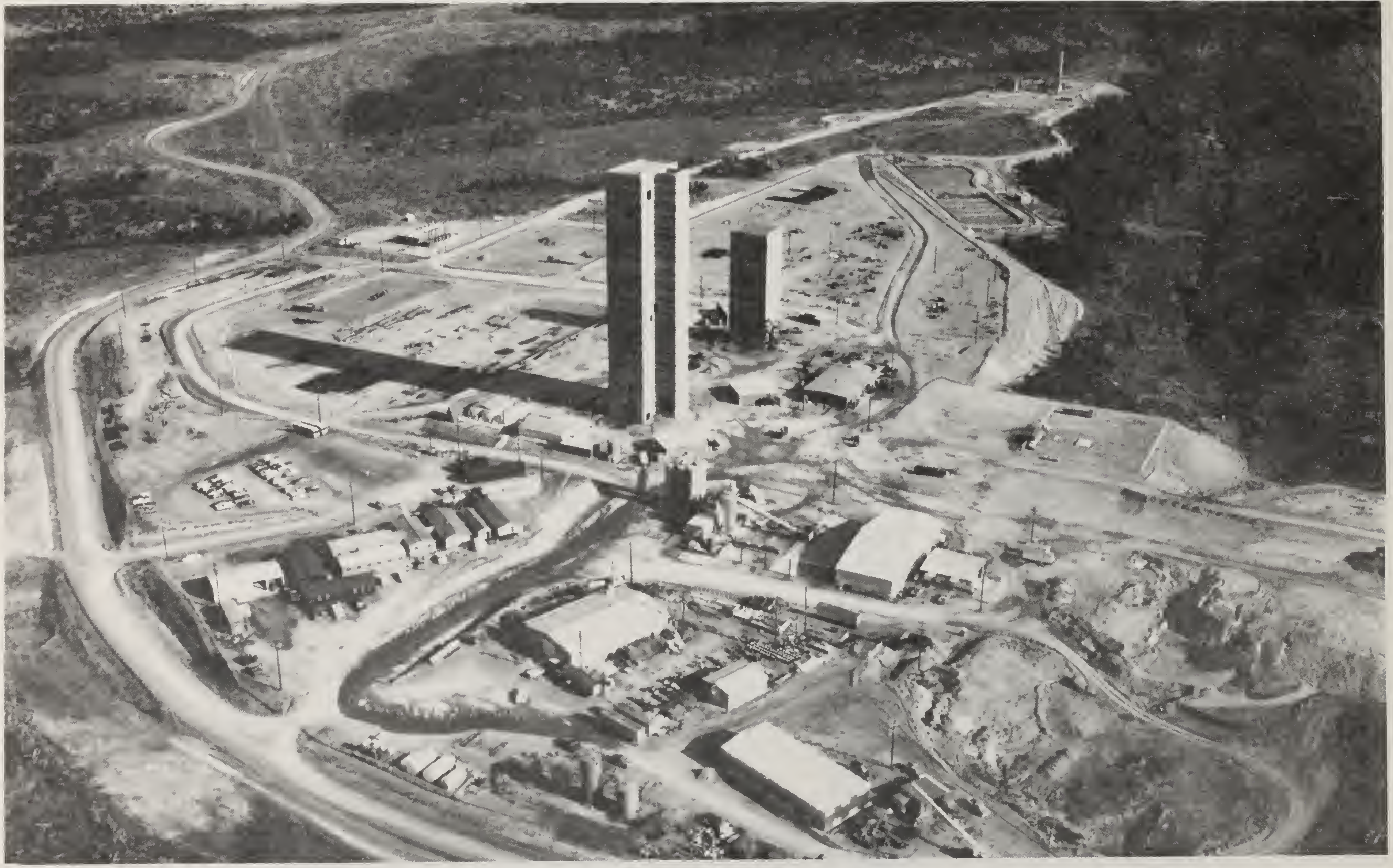

CATHEDRAL BLUFFS SHALE OIL PROJECT
AERIAL VIEW OF CB SITE FACILITIES

FOREWORD

The 1982 CB ANNUAL REPORT is submited to fulfill the requirements of Oil Shale Lease Number C-20341 as stated in Section 16(b) of the Lease, Section 1.(C)(4) of the Lease Environmental Stipulations, and Condition of Approval No. 3 of the Detailed Development Plan issued on August 30, 1977.

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SUMMARY OF DEVELOPMENT ACTIVITIES, COSTS AND ENVIRONMENTAL MONITORING

1.0 INTRODUCTION AND SUMMARY

This report summarizes the development activities, costs, and environmental monitoring on the Federal Oil Shale Lease Tract C-b during calendar year 1982. The Tract is leased to Cathedral Bluffs Shale Oil Company under U.S. Department of Interior Lease Number C-20341. It is managed by the equal-interest partnership between Occidental Oil Shale, Inc. and Tenneco Shale Oil Company, doing business as Cathedral Bluffs Shale Oil Company. The Tract is located in Rio Blanco County in the Piceance Creek basin of northwestern Colorado.

The project schedules for 1982 and 1983 contained herein both reflect the December, 1981 announcement that the entire project was being reassessed in view of current increased construction costs, reduced oil prices and high interest rates. Intense project activity occurred the latter part of 1982 to prepare three proposals to the Synthetic Fuels Corporation for a revised project scope characterized by:

Case A Proposal	Case B Proposal	Case C Pro Forma Proposal
11700 BPCD*	13500 BPCD	21300 BPCD
Above Ground Retorting (AGR)	Both AGR & Modified In Situ (MIS) Retorting	Both AGR & MIS
Room & Pillar Mining	Room & Pillar Mining	MIS Mining
Initial Production 1988	Initial Production 1988	Initial Prod. 1988
Full Scale Prod. 1990	Full Scale Prod. 1990	Full Scale Prod. 1991

* Barrels per calendar day

These proposals were submitted in January 1983.

Project expenditures in 1982 were approximately $29,700,000.

In addition to the Synthetic Fuels proposals, principal activities in 1982 were the continued outfitting of the headframes for the Production and Service Shafts and the continued water management program to treat and dispose of excess waters associated with mine dewatering.

In the Service Shaft the main cage and two auxiliary cages were installed. In the Production Shaft two 9500 hp Koepe friction hoists were installed. Each hoist will be equipped with two balanced "skips" for hoisting mined rock to the surface. A single skip has a payload of 52 tons, equivalent

to a hoist capacity of 1500 tons per hour per hoist. In 1982 only one hoist was "roped up".

As part of the Service Headframe four new structures were completed in 1982: the Control Room (for controlling all 5 hoists), the East and West Airlocks (which allow headframe access without disturbing the mine ventilation system), and the Mechanical/Electrical Rooms. In addition, the Power Substation on Tract became operational in 1982.

Water make for the shafts was as follows:

Shaft	1982 Year-End Water-Make (gpm)	Total for 1982 (million gal)	Cumulative Total To Date (million gal)
Ventilation/Escape	0	0	679
Production and Service	487	291	813
Total	487 (761)	291 (634)	1492* (1201)

Quantities for 1981 are shown in parantheses.

* An additional 18 million gal have been pumped from small wells for on-Tract use bringing the grand total to 1510 million gal.

The approved inactivation of the Ventilation/Escape (V/E) Shaft dewatering pumps in September 1981 allowed the above decrease in pumping rates from that in 1981.

In 1982 water management was achieved via two principal modes: subsurface reinjection and direct discharge from on-Tract holding ponds under the NPDES permit. Following the inactivation of the V/E Shaft and subsequent declines in dewatering rates the reinjection mode was temporarily discontinued in July 1982. To summarize for the year:

134	million	gal were discharged
127	"	gal were reinjected
0	"	gal were sprinkler irrigated
30	"	gal were used, evaporated, or leaked
291	million	gal were pumped.

No additional acreage was disturbed in 1982, maintaining the total to date at 188 (less than 4% of the Tract). Two acres for drill pads were reclaimed, bringing the total revegetated acreage to 35. Total acreage of the raw shale storage pile is eleven acres. It currently contains 126,000 cubic yards of raw shale.

Regarding environmental and health protection and control, in addition to water management already discussed, the following should be noted:

- Regarding air emissions, the cement batch plant ceased operation temporarily in 1982.

- No degradation in visual range has been noted since inception of the visibility program in 1975.

- A 9,000 gal/day capacity sewage treatment plant temporarily ceased operation in March; the current system is described in Section 7.4.

- 5 reportable accidents in 322,468 man hours on Tract resulted in an accident incident rate of 3.10.

- Special reflectors, installed along four one-mile sections of Piceance Creek Road in 1981 as a mitigation test to reduce deer road kill, continued to be used; no conclusions can yet be drawn on effectiveness of the reflectors.

Regarding socioeconomic impacts, the 1982 work force on Tract decreased from a year-end level of 600 in 1981 to a year-end level of 30. Total persons employed directly by CB, including Grand Junction staff, decreased slightly from 110 in January to 85 in December. The C-b employee bus system was temporarily discontinued. With four other oil shale projects, CB participated in procedures to finalize construction of a highway by-pass around Rifle. Occidental and Tenneco co-sponsored an oil shale exhibit at the 1982 World's Fair in Knoxville, Tennessee. It is estimated that 800,000 people toured this pavillion which simulated an oil shale mine.

Environmental monitoring has continued as an ongoing activity at the Tract since the completion of the two-year Baseline period (1974-1976). It encompasses air, water, and biology as well as studies of ecosystem interrelationships, toxicology, and health and safety. Results are summarized in Section 9 of this volume. No significant environmental impacts have been noted to date except for areas directly disturbed by drilling, construction, ponds, and mined rock disposal, drawdown of groundwater levels from mine dewatering, and some vegetation effects in previously sprinkler-irrigated areas.

This Annual Report serves to demonstrate compliance with the Detailed Development Plan (DDP), the Development Monitoring Plan (DMP) (both of which imply compliance with the Lease), and the Water Court Decree #W-3492, leading to the Water Augmentation Plan (WAP). A Requirements Compliance Matrix is presented in Table 1-1 showing where information relating to these controlling documents is addressed in the Annual Report and in the semiannual environmental data reports.

The following project abbreviations appear in this report:

CB - for Cathedral Bluffs, and
C-b - for Colorado-b Federal Oil Shale Lease Tract.

TABLE 1-1

Requirements Compliance Matrix

Controlling Document	Document Section	Section Subject	Annual Report Section or Chapter	Semi-Annual Data Report Section or Chapter	Comments
DDP	Volume I Section I	General Information and Summary	1, 2, 4, 7.11, 9		
	Section II	Phase I - Mine Development			
	A.	Schedule & Summary	3, 4		
	B.	Manpower	1, 8		
	C.	Engineering Design & Procurement	3.2, 4, 5		
	D.	Mine Surface Facilities	1, 3, 4		
	E.	Mine Shaft Sinking	1, 3, 4, 7.7		
	F.	Development Mine			
	G.	Utilities and Fuel	4, 7.3, 7.9		
	H.	Crushing and Conveying			
	I.	Alternate Mining Methods			
	J.	Access and Service Roads	4, 7.9		
	K.	Dams	7.2		
	L.	Coarse-Ore Conveyor & Stockpile			
	M.	Shaft Dewatering, Treatment & Disposal	4.1.10, 7.2	2.2.1, 2.2.2	
	Section III	Phase II - Plant Construction	5		
	A.	Summary	4		
	B.	Schedule & Manpower	3, 8		
	C.	On-Tract Surface Facilities	4		
	D.	Off-Tract Facilities	4		
	Section IV	Phase III & Phase IV			Not at this Phase of Development yet.
	A.	Summary - Phase III			" " " " " " "
	B.	Schedules and Manpower			" " " " " " "
	C.	Mine Operations			" " " " " " "
	D.	Crushing and Conveying			" " " " " " "
	E.	Retorting and Upgrading			" " " " " " "
	F.	Waste Disposal			" " " " " " "
	G.	Water Use			" " " " " " "
	H.	Electric Power Use			" " " " " " "
	I.	Utility Systems			" " " " " " "
	J.	Pipelines			" " " " " " "
	K.	Phase IV - Post Operations	7.10		" " " " " " "

TABLE 1-1 (Contd)

Controlling Document	Document Section	Section Subject	Annual Report Section or Chapter	Semi-Annual Data Report Section or Chapter	Comments
DDP	Section V	Environmental Control Plans	1, 7, 9		
	A.	Air Pollution Control	7.1		
	B.	Water Pollution Control	1, 7.2		
	C.	Noise Control	7.7.2, 9.3.7		
	D.	Protection of Historic, Scientific & Aesthetic Values	7.6, 9.3.11		
	E.	Fire Prevention & Control	1, 7.7.3		
	F.	Health and Safety	1, 7.7, 9.3.12, 9.3.13		
	G.	Overburden Management	6		
	H.	Processed - Shale Disposal	6		
	I.	Disposal of Other Wastes	4, 6, 7.4		
	J.	Fish and Wildlife Management	7.8, 9.3.4, 9.3.8		
	K.	Erosion Control and Surface Rehabilitation and Revegetation	6, 7.5, 9.3.9		
	L.	SPCC Plan	7.3		
	M.	Off-Tract Corridors	4.2.5, 7.9		
	Section VI	Environmental Monitoring			
	A.	Introduction	1, 9		
	B.	Soils Survey and Productivity Assessment	9	2.5.6	
	C.	Surface Water	1, 7.2, 9.3.3	2.2.1	
	D.	Sub-surface Water	1, 7.2, 9.3.3	2.2.1	
	E.	Meteorology and Air Quality	1, 7.1, 9.3.5,9.3.6	2.3.1, 2.3.3	
	F.	Biological	1, 6, 7.8, 9.3.4, 9.3.8, 9.3.9	2.5.1, 2.5.2, 2.5.3, 2.5.4, 2.5.5, 3.1, 5	
	G.	Noise	7.7.2, 9.3.7	2.4.1	
DMP	Section 1	Introduction	2, 9.1, 9.2		
	2	Milestones & Maps	3.1, 9.2, 9.3		
	3	Photography			
	3.1	Surface	1	2.1	
	3.2	Aerial	1, 4.3.10, 9.3.2	2.1	
	Section 4	Indicator Variables	1, 9.3.1, 9.3.10		
	5	Hydrology			
	5.2	Surface	1, 4, 7.2, 9.3.3	2.2.1, 2.2.3	
	5.3	Sub-Surface	1, 4, 7.2, 9.3.3	2.2.1, 2.2.3	
	5.4	Development	1, 4, 7.2	2.2.1, 2.2.3	

TABLE 1-1 (Contd)

Controlling Document	Document Section	Section Subject	Annual Report Section or Chapter	Semi-Annual Data Report Section or Chapter	Comments
DMP	Section 5.5	Systems Dependent	1, 4, 7.2		
	5.6	Quality Assurance	1, 9.3.14	2.2.4	
	6	Air Quality & Meteorology			
	6.2	Ambient Air Quality	1, 7.1, 9.3.5	2.3.1, 2.3.4	
	6.3	Meteorology	1, 7.1, 9.3.6	2.3.3	
	6.4	Development - Related	1, 7.1		
	6.5	Systems Dependent	1		
	6.6	Quality Assurance	1, 9.3.14	2.3.8	
	7	Noise	1, 7.7.2, 9.3.7	2.4.1	
	8	Biology	1, 6, 9.3.4, 9.3.8, 9.3.9	2.5.1 to 2.5.5, 3.1, 5	
	8.2	Big Game - Deer	1, 9.3.8	2.5.1	
	8.3	Medium Sized Mammals	1, 9.3.8	2.5.1	
	8.4	Small Mammals	1, 9.3.8	2.5.1	
	8.5	Avifauna	1, 9.3.8	2.5.1	
	8.6	Aquatic	1, 9.3.4	2.5.2	
	8.7	Terrestrial	1, 9.3.9	2.5.1	
	8.8	Threatened & Endangered	1, 9.3.8	2.5.4	
	8.9	Revegetation	1, 6	2.5.5	
	8.10	Systems Dependent	1	5	
	Section 9	Items of Historic, Prehistoric or Scientific Interest	1, 9.3.11	2.6	
	10	Industrial Health & Safety	1, 7.7, 9.3.12, 9.3.13	2.7	
	11	Subsidence Monitoring			
	12	Ecosystem Interrelationships	9.3.10		
	13	Data Management & Reporting	9.1, 9.3.14, 9.3.15	4.0	
Water Court Decree W-3492	7	Legal Description of Site	2		
	8	Sources of Water Supply	4.1.10, 9.3.3		
	9, 10, 11	Dewatering & Augmentation	7.2, 9.3.3	2.2.1, 2.2.3	
	25	Monitoring Program Requirements for Evidence of Depletion Effects	7.2, 9.3.3	2.2.1, 2.2.3	Exhibit A, wells, springs, seeps, streams, precipitation sites. Exhibit B, Development Monitoring Program.
	26	Timely Implementation Requirement		2.2.1, 2.2.3	
	27	Tracking Cone of Depression	9.3.3	2.2.1, 2.2.3	
	29	Cone of Depression Determination & Monitoring via Stream Flows, Correlations, etc.	9.3.3		

2.0 DESCRIPTION OF PROJECT AREA

2.1 Location

Federal Oil Shale Tract C-b is located in the Piceance Creek structural basin between the Colorado River on the south and the White River on the north. The basin is dominated by a large central plateau which represents more than 75 percent of the basin's land surface. The area represents a sparsely populated portion of the Rio Blanco County in northwestern Colorado. Terrain on the Tract consists primarily of undulating valleys and ridges trending in the northeasterly direction and draining into Piceance Creek. The northern edge of the Tract is approximately one-half mile south of Piceance Creek between Willow Creek and Stewart Gulch. West of the Tract Piceance Creek flows northwesterly approximately 24 miles to its confluence with the White River. Irrigated-grassland ranching predominates along Piceance Creek. The towns nearest to the Tract are Meeker (45 miles), Rifle (42 miles), Parachute (62 miles) and Rangely (65 miles).

Elevations on the Tract vary from 6,400 feet in the lowest valley bottoms to 7,100 feet on the ridges near the southern edge of the Tract. The climate is semiarid with snow cover occurring variably from October to May. The climate supports sparse vegetation, with sagebrush and pinyon-juniper communities being dominant. Historically, the Tract has been used primarily for cattle grazing and winter range for mule deer. As part of a BLM range improvement program, approximately 45 percent of the Tract (primarily the flat ridgetops) was chained in 1967. The technique was intended to improve range production by removing pinyon-juniper trees, thus permitting growth of grazeable understory.

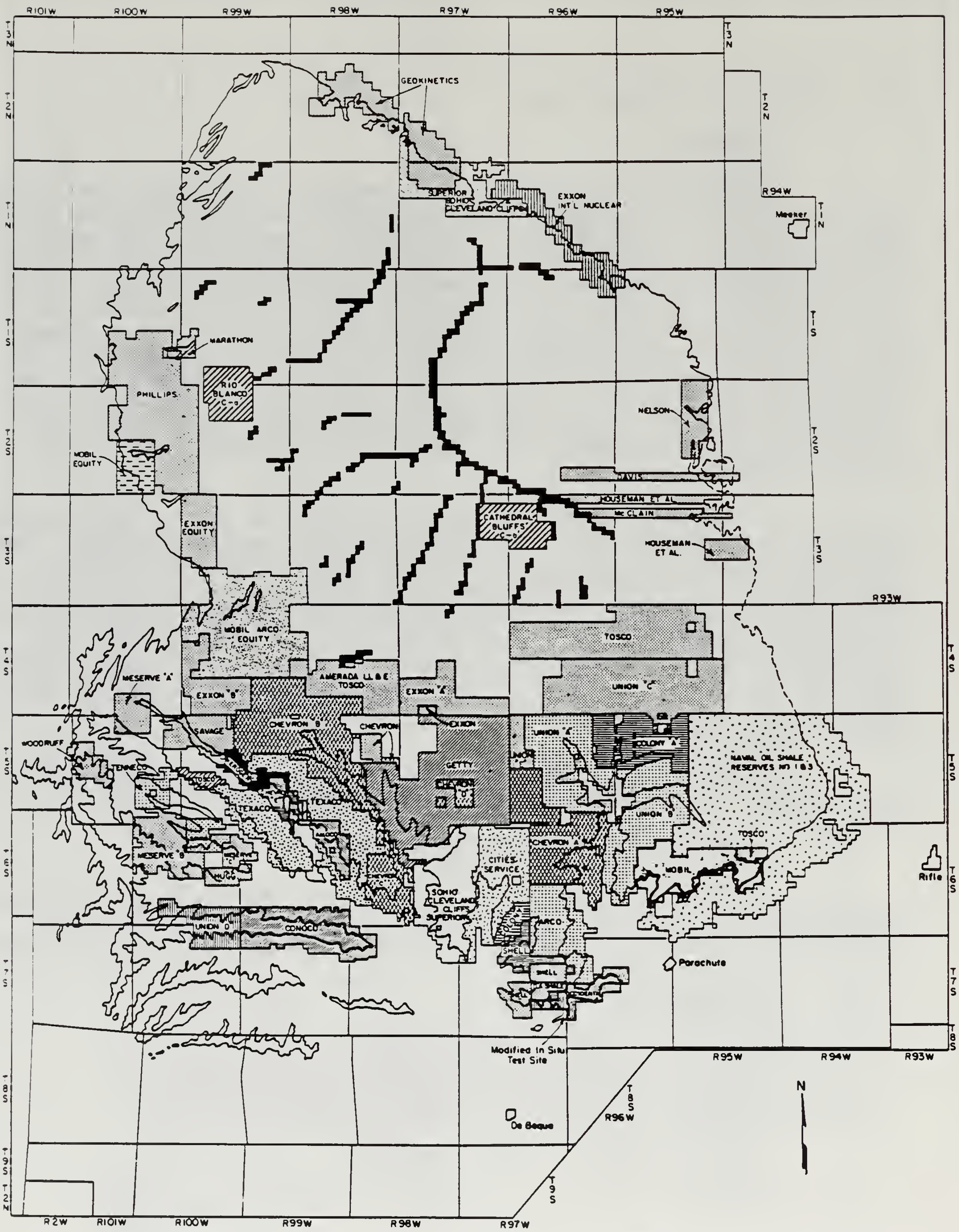
Location of the Tract relative to other existing and proposed oil shale projects in northwestern Colorado is shown on Figure 2-1.

2.2 Legal Description of the Leased Land

The Tract, as legally described in U. S. Department of the Interior Oil Shale Lease C-20341, consists of 5,093.9 acres, more or less, which is shown in Figure 2-2 and is located in Rio Blanco County, Colorado, as follows:

T3S, R96W, 6th P.M.

Section 5, W 1/2, SE 1/4, and SW 1/4;
Section 6, lots 6 and 7, E 1/2 SW 1/4, and E 1/2;
Section 7, lots 1, 2, 3, and 4, E 1/2 W 1/2, and E 1/2;
Section 8, W 1/2, NE 1/4, NW 1/4, and S 1/2;
Section 9, SW 1/4;
Section 16, NW 1/4, and W 1/2 SW 1/4;
Section 17;
Section 18, lots 1, 2, 3, and 4, E 1/2 W 1/2, and E 1/2;



EXPLANATION

- Fee Lands (Ownerships not shown)
- Unpatented Oil Shale Mining Claims (Ownership posted)
- Patented Oil Shale Mining Claims (Various patterns used to accentuate posted ownership)
- Naval Oil Shale Reserve Lands
- Federal Oil Shale Leases
- Mahogany Marker Outcrop

NOTE Undifferentiated Oil Shale Land is owned by Federal Government.

Figure 2-1
OIL SHALE MINERAL RIGHT OWNERSHIP OF MAJOR LAND HOLDINGS
NORTHERN PICEANCE BASIN
NORTHWESTERN COLORADO

1 2 3 4 5 6 Miles
SCALE

1981

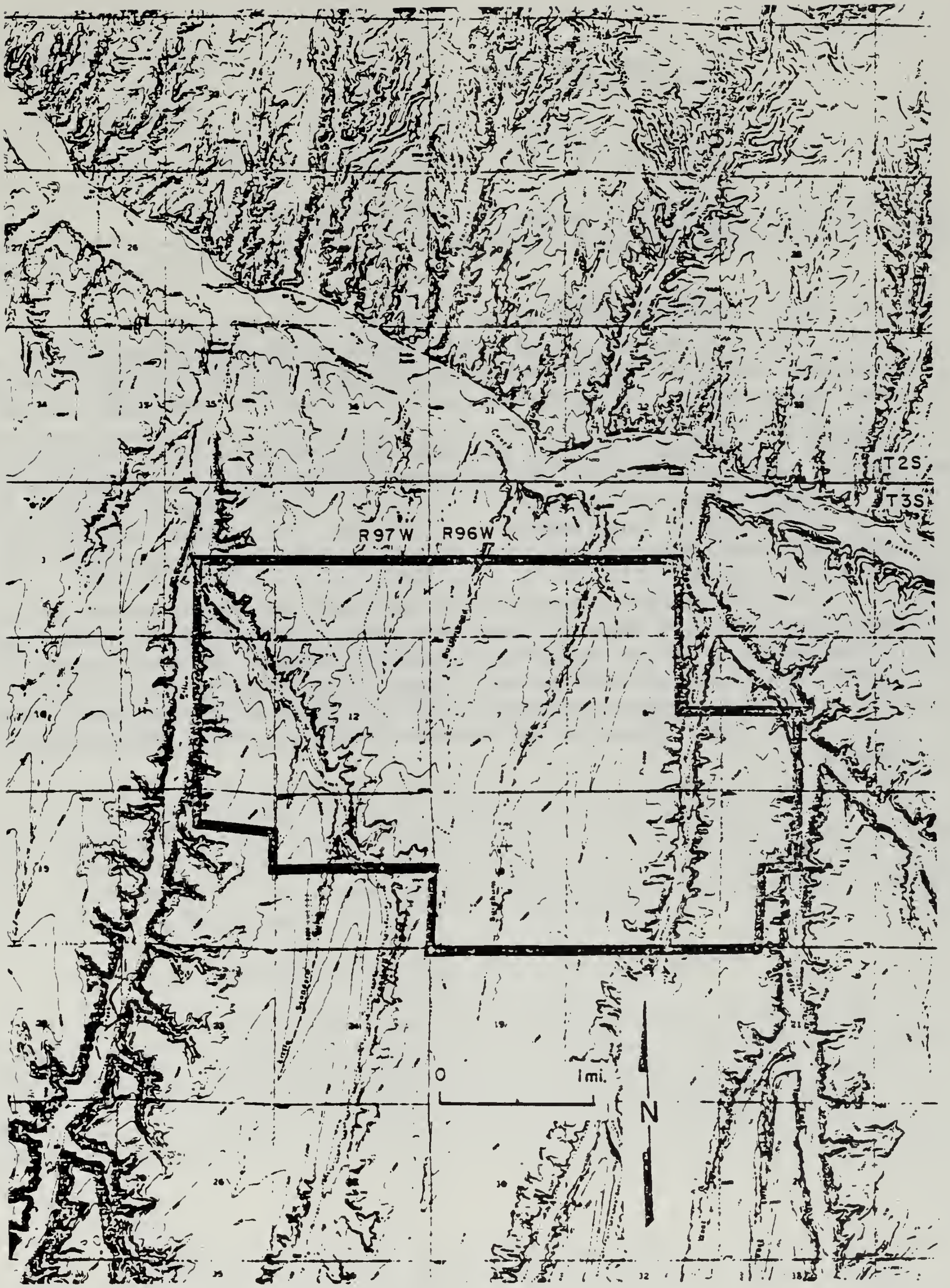


Figure 2-2
Location of tract C-b according to range, township and section

T3S, R97W, 6th P.M.

Section 1, S 1/2;
Section 2, SE 1/4;
Section 11, E 1/2;
Section 12;
Section 13, N 1/2;
Section 14, N 1/2 NE 1/4.

2.3 Leasehold Status

The Lease requires that a Detailed Development Plan (DDP) be developed prior to its third anniversary date. Such a plan was developed for underground mining and surface retorting in 1976. A plan modification to incorporate modified insitu retorting was prepared with options and alternatives for surface retorting and power generation in 1977. The scope of the DDP was further amended in 1982 under an Interim Development Program and judged by the Deputy Minerals Manager for Oil Shale (DMM-OS) to be entirely consistent with Due Diligence Requirements of the Lease. This Annual Report is a requirement of the Lease and summarizes operations conducted under the DDP.

Furthermore, the Lease stipulates that operations be conducted in compliance with all Federal, State and local regulations and laws. Lease Environmental Stipulations are set forth to protect the environment; the current environmental monitoring program called Interim Monitoring is consistent with these stipulations and forms part of the Detailed Development Plan. This Annual Report also summarizes results of the environmental program.

3.0 SCHEDULE AND COSTS

3.1 Schedule

3.1.1 "Milestone" Schedule

The DMM-OS-approved "Milestone" or Project Guide Schedule is given on Figure 3-1. This schedule has been modified by subsequent DMM-OS action as follows:

- An interim operation plan was approved on September 1, 1981 which allows the V/E Shaft to fill with water under upset conditions (including mine water from all three shafts) until it is necessary to draw down the water for mine development.

- An Interim Monitoring Program was approved on March 17, 1982 and revised on July 22, 1982 to reflect the reduced level of activity on tract through March 1983.

- An Interim Development Program and Schedule was approved on July 22, 1982 to reflect the reduced level of activity commensurate with the December, 1981 announcement by CB management that the entire project was being reassessed due to oil prices, interest rates and project costs. This schedule which was included in last year's Annual Report is given on Figure 3-2. The primary goal of this revised schedule continues to be to arrive at an optimized project configuration and to complete a design basis by the first quarter of 1984.

- As discussed elsewhere, design optimization proceeded to the point which allowed submittal of proposals to the Synthetic Fuels Corporation for financial participation in the project. The schedule included in the SFC Proposal for Case B is given on Figure 3-3 for information. It is similar to and consistent with the DMM-OS-approved Interim Development Schedule of Figure 3-2.

3.1.2 Schedule vs. Actual Activities in 1982

Figure 3-4 shows site preparation and construction activities from 1981-1983 compared with the previously developed milestone schedule for this time span. Because of the aforementioned decision to reassess the project, on-tract activities were significantly reduced. Construction work underway in 1981 was completed in 1982 by the contractors noted in Table 3-1.

3.2 Costs

Financial information for 1982 is presented in Table 3-2 for the following categories: field construction, engineering, operating costs, environmental, other programs, general and administrative. Total expenditures for the year were $29,684,000.

TABLE 3-1

1982 Major Contractors and Responsibilities*

Bechtel	Project definition studies
Brown & Caldwell	Water management studies
Canadian General Electric	Supervising hoist installation
Colorado River Water Control District	Surface-stream monitoring program
Colorado Ute	Off-site electrical sub-station design and procurement
Dravo	Shaft/Headframe engineering
Geothermal Surveys, Inc.	Hydrologic monitoring programs and subsurface reinjection program implementation
Gilbert Corporation	Sink Production, Service and V/E Shafts
Harrison International Corporation	Outfitting headframes
Ortloff Minerals Services	Operation and maintenance labor and minor construction
Scott-Ortech	Mine gas monitoring

* See also Section 4.1.12 for additional off-Tract contractors

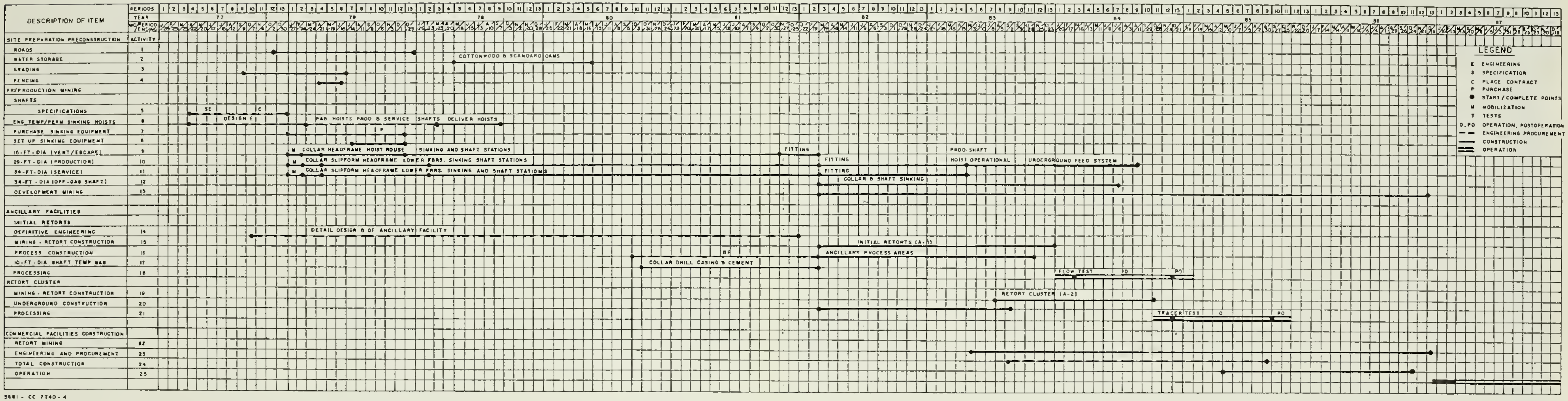


FIGURE 3-1
OVERALL PROJECT GUIDE SCHEDULE

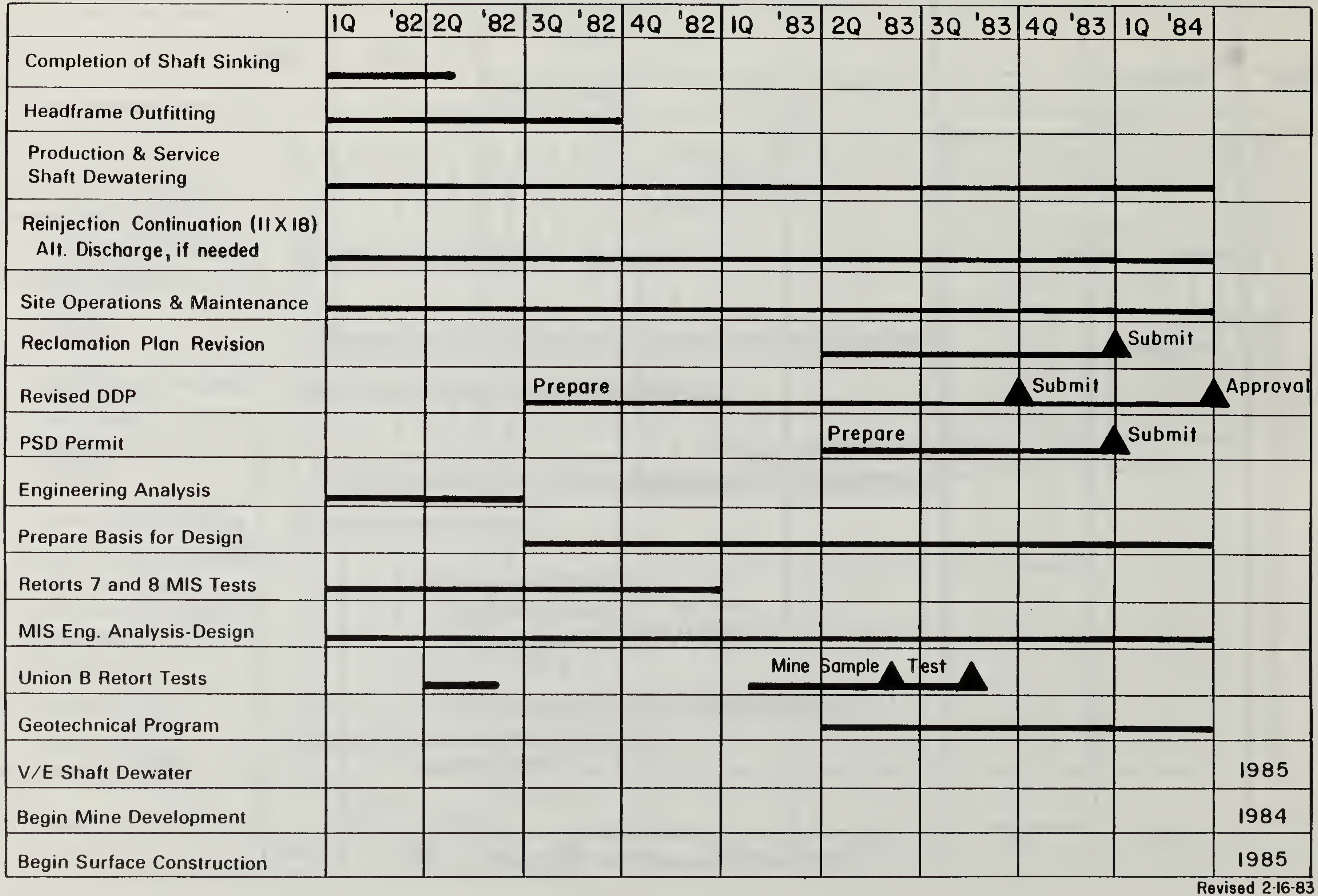


Figure 3-2 Interim Development Schedule
(Approved July 22, 1981)

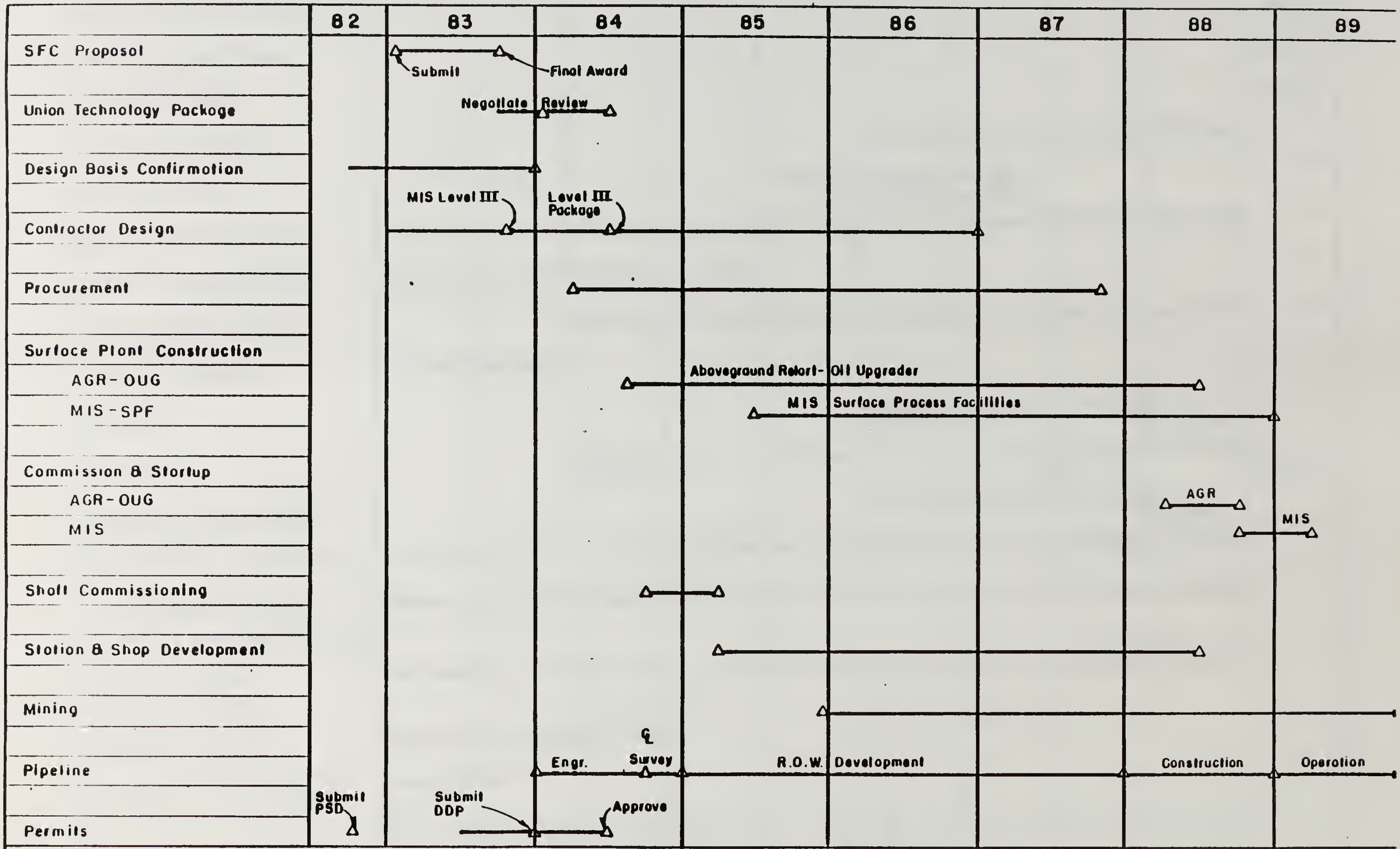


FIGURE 3-3 MASTER PROJECT SCHEDULE

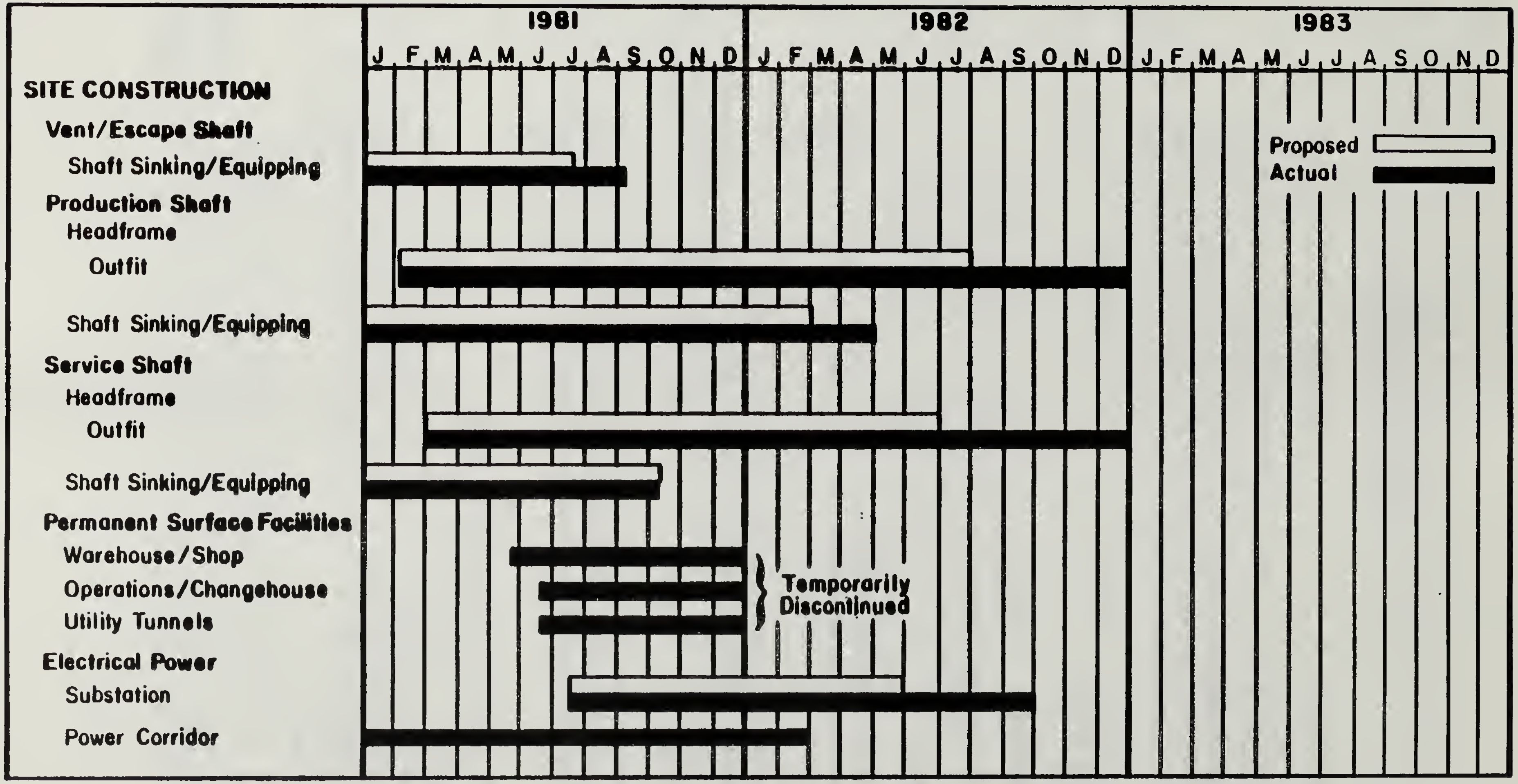


Figure 3-4
C.B. Construction Activities in 1981-1983

TABLE 3-2

1982 CB Expenditures
(Thousands of $)

Field Construction		
Managing Contractor and Engineering	$ 1,374	
Shaft Sinking	2,421	
Headframe Construction	9,222	
Power Generation Costs	465	
Other Construction	3,335	
		$16,817
Engineering Costs		718
Operating Costs		
Tract Operations and Maintenance		2,337
Environmental		
Air Quality and Hydrology	199	
Water Resource Development	52	
Biology and Reclamation	40	
Permits	(30)	
Systems Analysis and Reporting	-	
Environmental DDP	(27)	
		234
Other Programs		
Housing	129	
Busing	644	
Insurance, Bonding and Property Taxes	(211)	
Other	382	
		944
General and Administrative Staff Costs		
Environmental Staff	693	
All Other Staff	6,039	
Employment Expenses	440	
Legal Expense	435	
Office Expense	401	
Other Expense	315	
Overhead	311	
		8,634
TOTAL PROJECT		$29,684

4.0 DEVELOPMENT ACTIVITIES

This chapter describes 1982 development activities relative to on-Tract facilities in Section 4.1, off-Tract facilities in Section 4.2, access/service and support in Section 4.3 and mining in Section 4.4.

4.1 On-Tract Facilities Description

4.1.1 General Arrangement

Construction activities in 1982 consisted primarily of completing the installation of steel in the shafts in the beginning of the year and finishing the outfitting of the headframes by year end.

The following figures show progress to date of the various facilities on-Tract:

Figure 4-1:	C-b Tract Topographic Map (jacket map)
Figure 4-2:	Mine Support Area
Figure 4-3:	V/E Shaft and Ponds A & B
Figure 4-4:	Guard Building and Heliport
Figure 4-5:	Pond C Area
Figure 4-6:	Explosives Storage Area

The key to the facility numbers shown on the above figures is given on Table 4-1.

A near-Tract facilities inventory format was initiated in the 1980 report; it is further detailed on Table 4-2 to show all facilities removed or completed on-Tract in 1982. An inventory of disturbed acreage is given in Chapter 6 and hazardous materials in Chapter 7.

Aerial views of the Tract from previous reports clearly point out that Production and Service Headframes dominate the aboveground development with the Production Headframe being the taller structure.

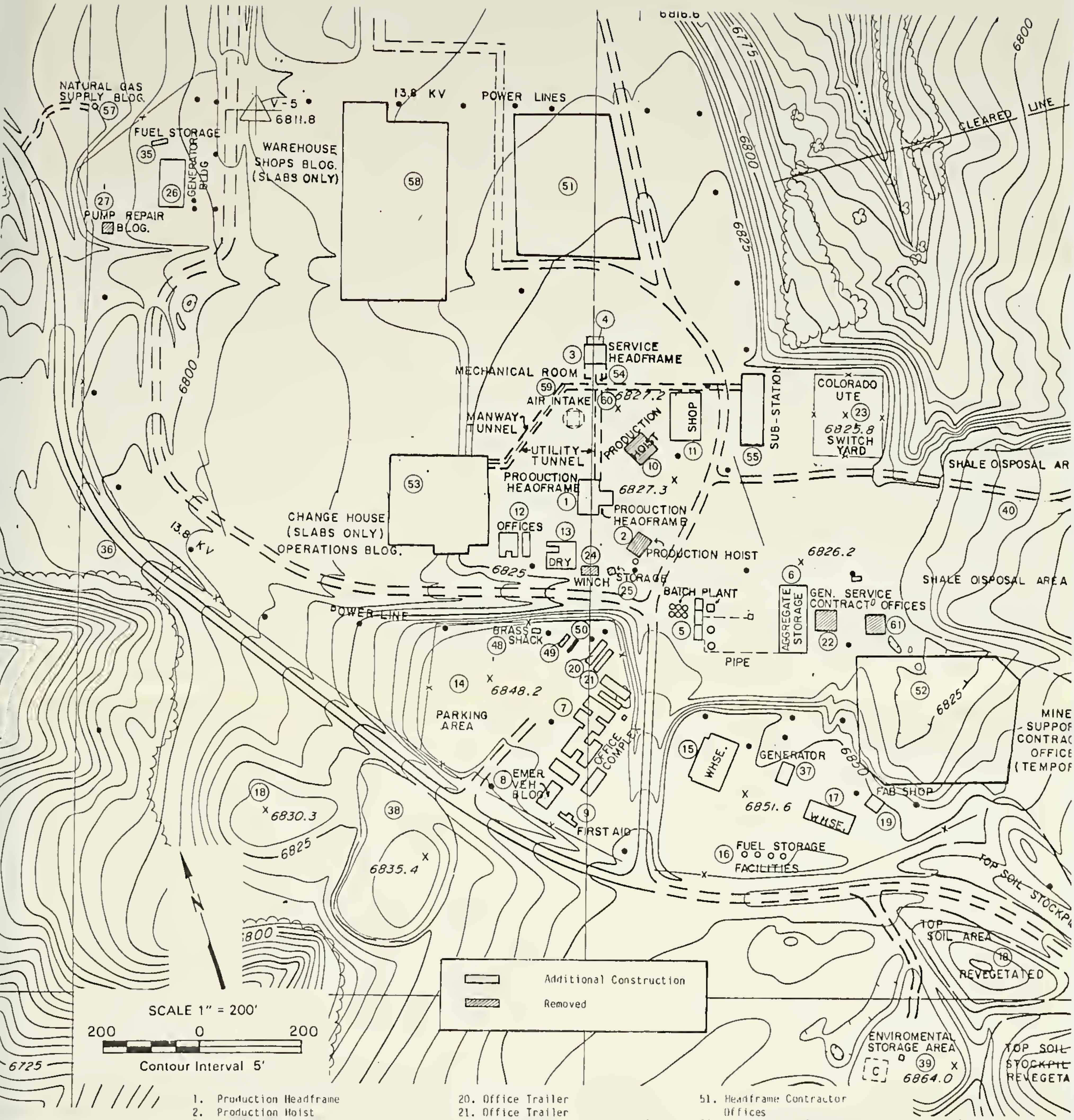
4.1.2 Production Shaft Headframe

The Production Shaft and Headframe will serve as the main "mined-rock" hoisting facility during commercial operation. Construction of the 29-foot diameter Production Shaft was begun in February, 1978, when it was "collared in" to approximately 70-foot depth by conventional excavation methods. The 313-foot headframe was "slipformed" in 28 days during September and early October, 1978.

With the completion of the upper skip hoist floor in November, 1981, all concrete floors were in place and ready for installation of all equipment. A vertical cross section of the Production Headframe is shown on Figure 4-7. The headframe contains the following floors (from top to bottom): upper skip hoist floor, lower skip hoist floor, upper power floor,

TABLE 4-1
FACILITIES LIST

1.	Production Headframe	Figure 4-1
2.	Production Hoist	Figure 4-2
3.	Service Headframe	Figure 4-2
4.	Control Room	Figure 4-2
5.	Cement Batch Plant	Figure 4-2
6.	Cement Batch Plant Aggregate Storage	Figure 4-2
7.	Office Complex	Figure 4-2
8.	Emergency Vehicle Building	Figure 4-2
9.	First Aid Trailer	Figure 4-2
10.	Production Hoist	Figure 4-2
11.	Shop	Figure 4-2
12.	Offices	Figure 4-2
13.	Dry	Figure 4-2
14.	Parking Area	Figure 4-2
15.	Main Warehouse	Figure 4-2
16.	Fuel Storage Facilities	Figure 4-2
17.	Warehouse	Figure 4-2
18.	Topsoil Storage Area	Figure 4-2
19.	Fabrication Shop	Figure 4-2
20.	Office Trailer	Figure 4-2
21.	Office Trailer	Figure 4-2
22.	General Service Contract Offices	Figure 4-2
23.	Colorado Ute Switchyard	Figure 4-2
24.	Winch	Figure 4-2
25.	Storage Building	Figure 4-2
26.	Generator Building	Figure 4-2
27.	Pump Repair Building	Figure 4-2
28.	Pond A	Figure 4-3
29.	Pond B	Figure 4-3
30.	Pumphouse	Figure 4-3
31.	V/E Hoist House	Figure 4-3
32.	V/E Headframe	Figure 4-3
33.	Shop	Figure 4-3
34.	Dry	Figure 4-3
35.	Fuel Storage	Figure 4-2
36.	Paved Main Access Road	Figs.4-2,4-4
37.	Generator	Figure 4-2
38.	Storage Yard	Figure 4-2
39.	Environmental Storage Building	Figure 4-2
40.	Shale Disposal Area	Figure 4-2
41.	Backwash Pit	Figure 4-3
42.	Public Relations Trailer	Figure 4-4
43.	Acid Injection Building	Figure 4-3
44.	Guard House	Figure 4-4
45.	Truck Scale	Figure 4-4
46.	Heliport	Figure 4-4
47.	L'eau Claire Filter	Figure 4-5
48.	Brass Shack	Figure 4-2
49.	Hydro/Air Lab	Figure 4-2
50.	Soils Lab	Figure 4-2
51.	Headframe Contractors Offices	Figure 4-2
52.	Mine Support Contractors Offices	Figure 4-2
53.	Changehouse/Operations Bldg. Slab	Figure 4-2
54.	Mechanical Room - Service Shaft	Figure 4-2
55.	Mine Support Area Substation	Figure 4-2
56.	Temporary Sewage Treatment Plant	Figure 4-4
57.	Natural Gas Supply Buildilng	Figure 4-2
58.	Warehouse/Maintenance Shop Building Slab	Figure 4-2
59.	Manway Tunnel from Changehouse to Service Headframe	Figure 4-2
60.	Utility Tunnels from Substation to S/P Headframes & Changehouse	Figure 4-2
61.	General Service Contractors Office	Figure 4-2
62.	Pond C	Figure 4-5
63.	Explosives Storage Area	Figure 4-6
64.	Pumphouse at Pond C	Figure 4-5
65.	Reinjection Well	Figure 4-5
66.	Eyewash and Shower Facility at Ponds A & B	Figure 4-3
67.	Flocculant Feed Tank Facility at Ponds A & B	Figure 4-3
68.	L'eau Claire Back-Flush Pit	Figure 4-5
69.	Access Road to Temporary Sewage Plant	Figure 4-4
70.	Meteorological Tower	Figure 4-5
71.	Air Quality Trailer (Station 023)	Figure 4-5



1. Production Headframe
2. Production Hoist
3. Service Headframe
4. Control Room
5. Cement Batch Plant
6. Cement Batch Plant Aggregate Storage
7. Office Complex
8. Emergency Vehicle Building
9. First Aid Trailer
10. Production Hoist
11. Shop
12. Offices
13. Dry
14. Parking Area
15. Main Warehouse
16. Fuel Storage Facilities
17. Warehouse
18. Topsoil Storage Area
19. Fabrication Shop
20. Office Trailer
21. Office Trailer
22. General Service Contract Offices
23. Colorado Ute Switchyard
24. Winch
25. Storage Building
26. Generator Building
27. Pump Repair Building
35. Fuel Storage
36. Paved Main Access Road
37. Generator
38. Storage Yard
39. Environmental Storage Building
40. Shale Disposal Area
48. Brass Shack
49. Hydrology/Air Laboratory
50. Soils Lab
51. Headframe Contractor Offices
52. Mine Support Contractors Offices
53. Changehouse/Operations Building (slabs only)
54. Mechanical Room-Service Shaft
55. Mine Support Area Substation
57. Natural Gas Supply Building
58. Warehouse/Maintenance Shop (slabs only)
59. Manway Tunnel from Changehouse to Service Headframe
60. Utility Tunnels from Substation to Service/Production Headframes and Changehouse
61. General Service Contractors Office

Figure 4-2

Topographic map showing facilities in the Mine Support Area

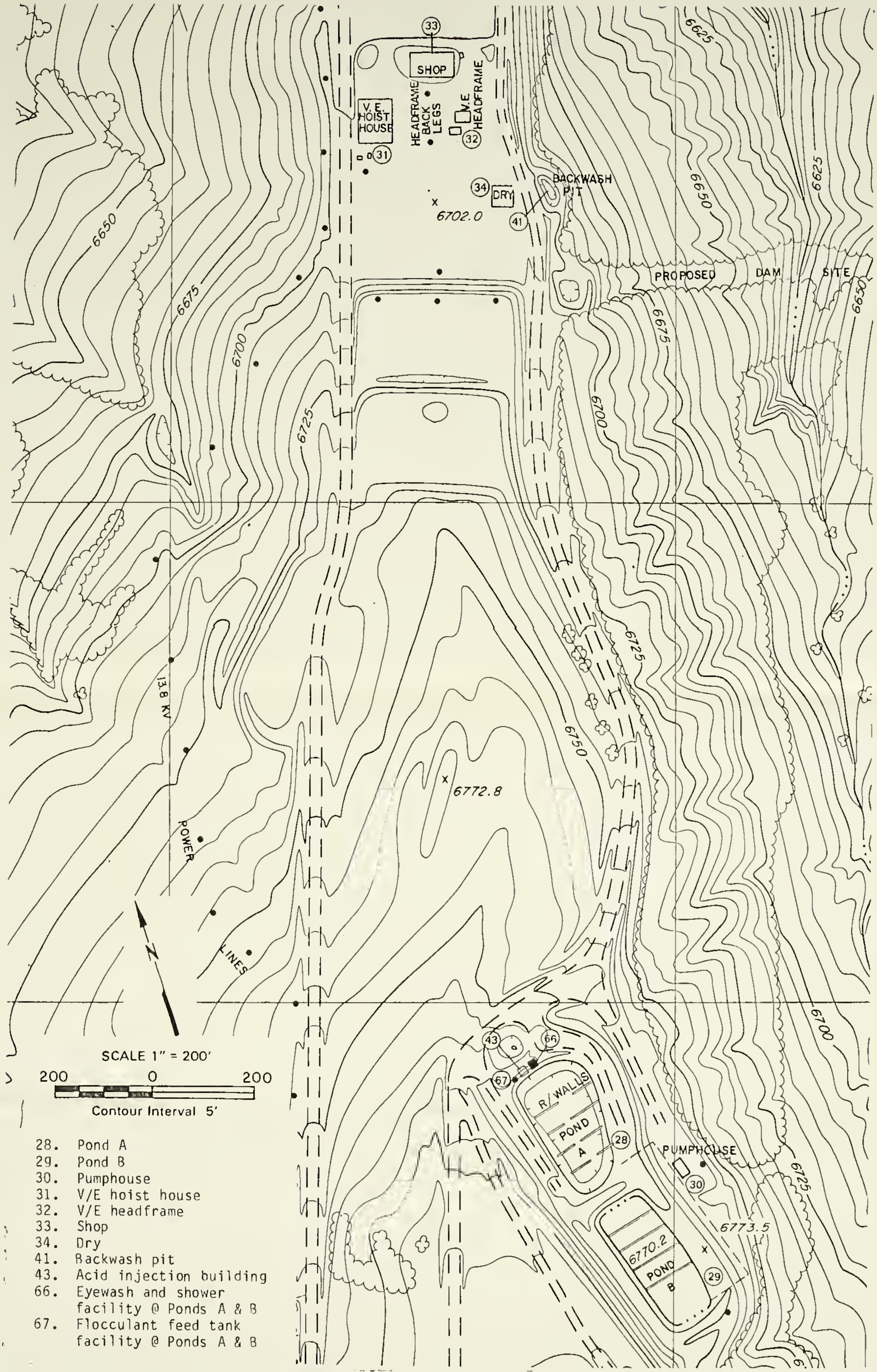


Figure 4-3

Topographic map showing facilities near the V/E Shaft and Ponds A and B

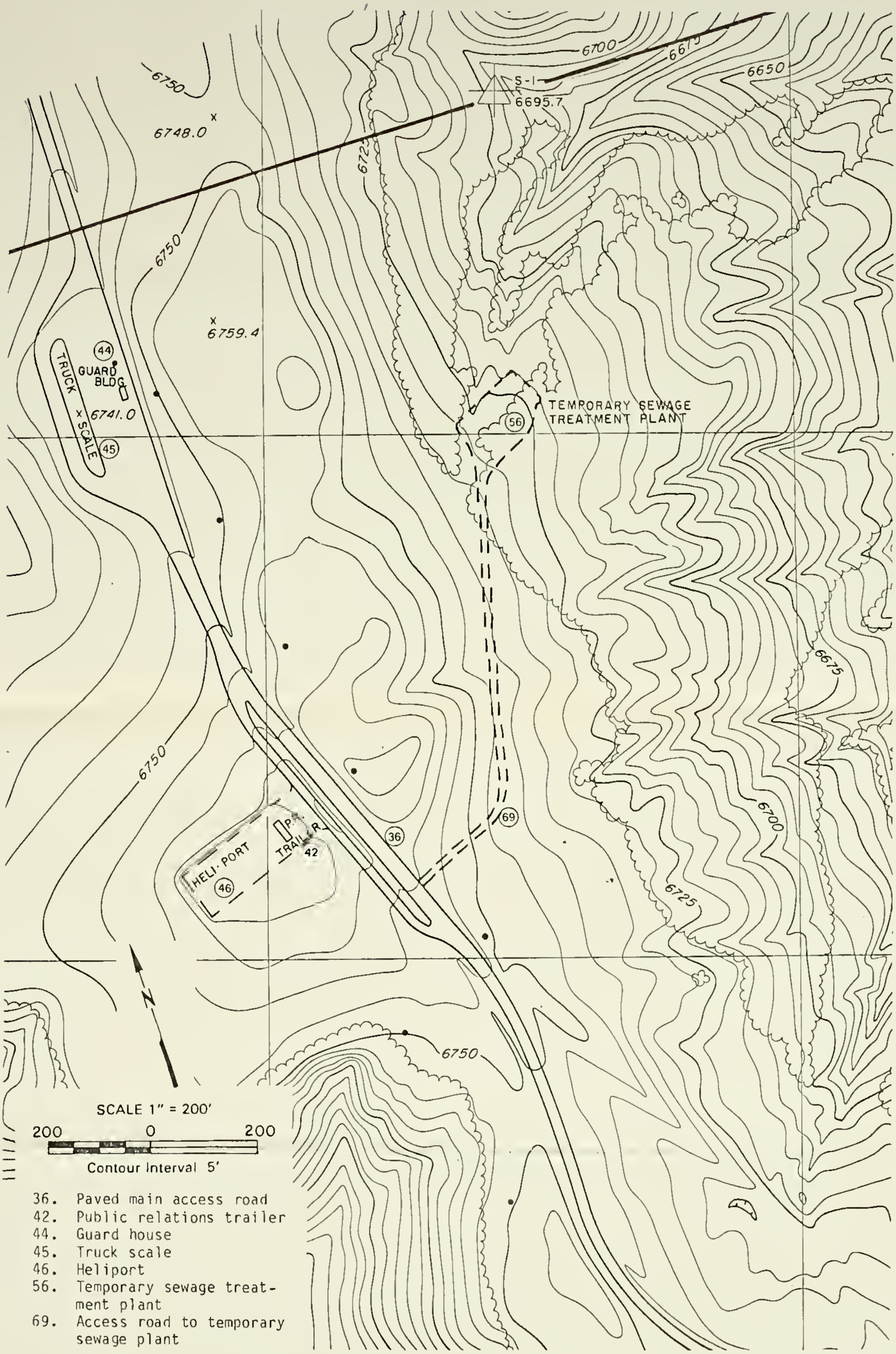
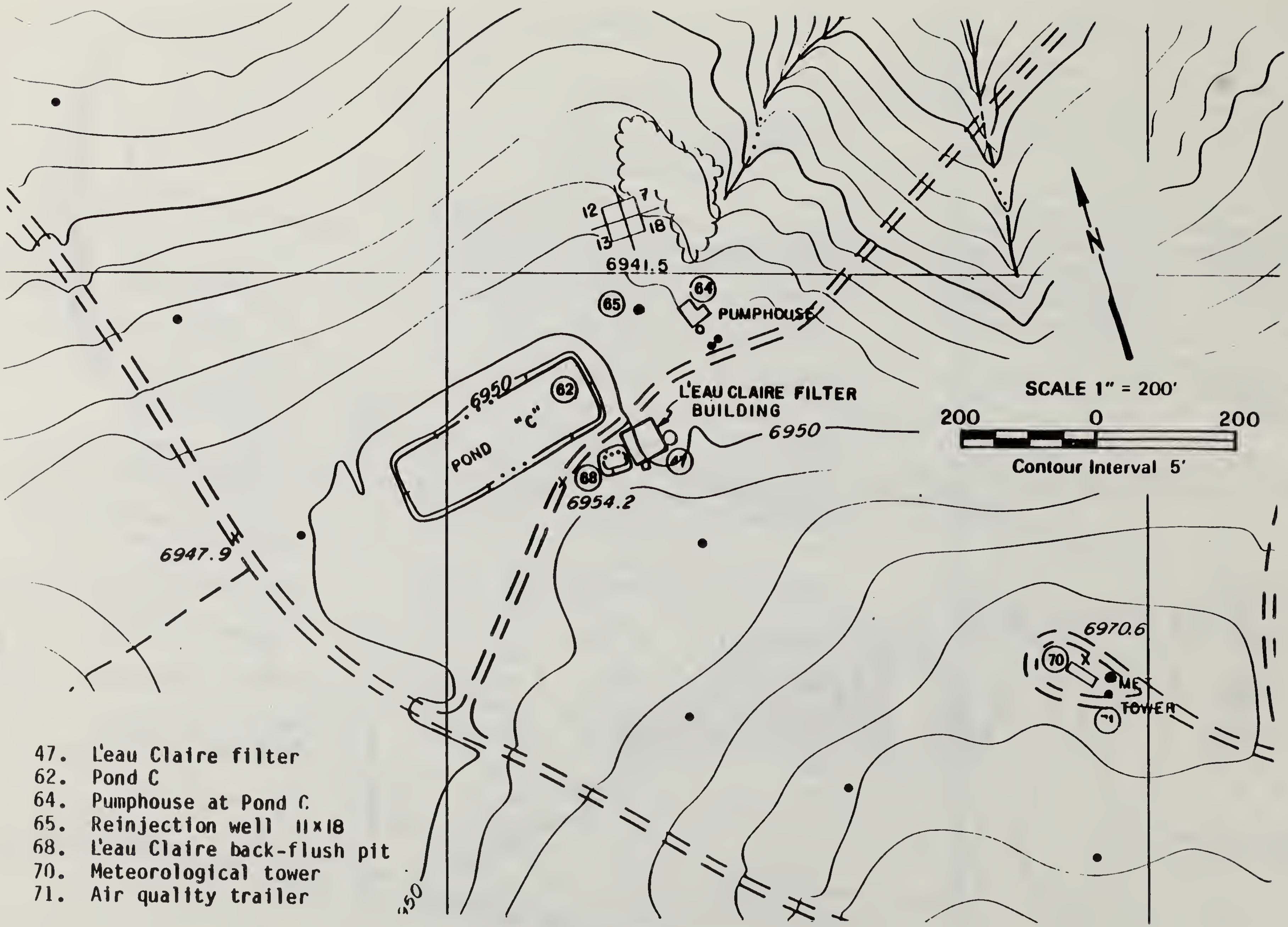


Figure 4-4

Topographic map showing facilities near the Guard Building and Heliport



47. L'eau Claire filter
62. Pond C
64. Pumphouse at Pond C
65. Reinjection well 11x18
68. L'eau Claire back-flush pit
70. Meteorological tower
71. Air quality trailer

Figure 4-5

Topographic map showing facilities near Pond C

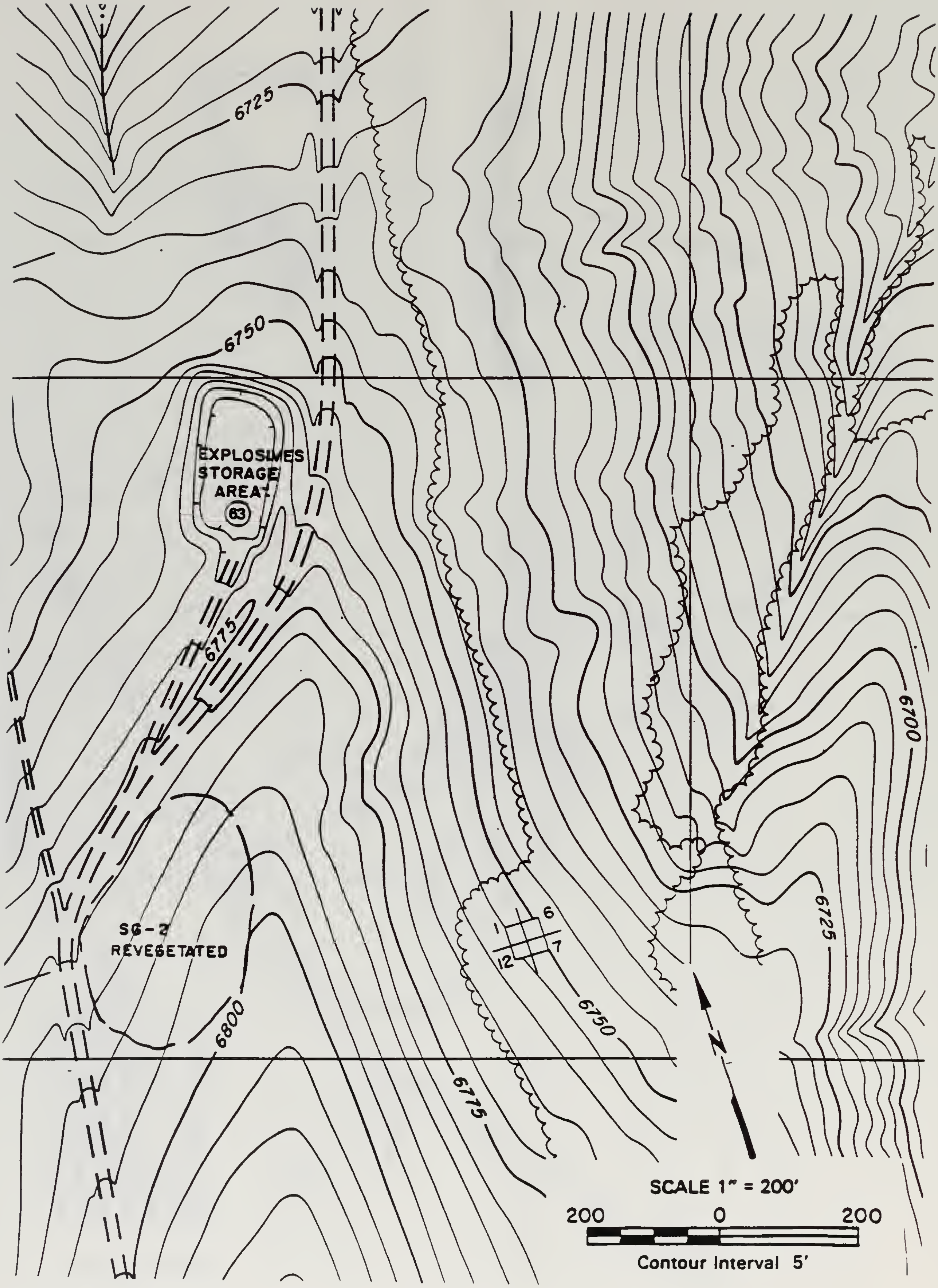


Figure 4-6

Topographic map showing facilities near the Explosives Storage area

TABLE 4-2

On-Tract Facilities Added/Removed in 1982

Facility No.	Description/ Use	Approximate Size (ft x ft)	Colorado N	Coordinates*(ft) E	Shown On Figure	Completion Date/Year	Removal Date Year
4	Control Room	20' x 40'	184,600	1,234,800	4-2	1982	
2	Production Hoist-Shaft Sinking	30' x 40'	184,200	1,234,800	4-2		1982
10	Production Hoist-Shaft Sinking	50' x 50	184,400	1,234,800	4-2		1982
22	General Service Contract Offices	40' x 40'	183,900	1,235,000	4-2		1982
24	Winch-Shaft Sinking	20' x 30'	184,100	1,234,600	4-2		1982
25	Storage Building	10' x 10'	184,100	1,234,700	4-2		1982
27	Pump Repair Building	20' x 20'	184,900	1,234,000	4-2		1982
61	General Service Contractors Office	40' x 40'	183,800	1,235,100	4-2		1982

* Approximate Center

lower power floor, dump floor, collar floor (ground level), and feeder floor (below grade).

Construction to equip the headframe continued from 1981 through 1982. The major installations in the headframe are the two Koepe friction hoists built by Canadian General Electric (Figure 4-8). Each hoist is equipped with a 9500 horsepower motor which runs the rock skips at a speed of 2920 feet per minute. This results in hoist "cycle time" of 93 seconds (time interval between loading the skip underground and dumping it in the surface bin). Mined rock is moved from underground by way of four skips with two balanced skips per hoist. These skips are hung from six 2-1/8" headropes and balanced by four 2-5/8" tailropes (Figure 4-9). Each skip is guided down the shaft by four 1-3/4" guideropes (eight guideropes per hoist). A single skip has a payload of 52 tons, equivalent to a hoist capacity of 1500 tons per hour per hoist.

Following the setting and aligning of the sole plates on which the remainder of the hoist is set, installation of the hoists was initiated on January 14, 1982. Each hoist consists of the following components (in order of installation): bearing pedestals, drum, shaft, armature, motorframe, brush assembly, brake engines, and auxiliary package (controls). Installation of each segment of the hoist was a major task considering its weight. For example, the drum weighs 52 tons and the brake engines weigh 20 tons each. Every piece was lifted 200 feet into the headframe via a 60-ton bridge crane. All remaining equipment in the headframe was similarly lifted. Mechanical erection of the hoists was completed on May 6, 1982. Electrical connection of the hoists and controls followed this activity.

The major task that remained to be completed on the hoist was to "rope-up". Roping-up is the installation of headropes, tailropes, guideropes, skip bail and all attachments needed to connect the ropes to the skip. Rope-up of skip hoist "A" (Figure 4-10) was started on September 7, 1982 and completed October 19, 1982 with the exception of completing the final connection to one of the skips. Skip hoist "B" will not be roped-up at this time, but will be mechanically and electrically completed.

Other systems installed in the headframe during the year that directly support the hoists include air compressors and piping to release the brakes on the hoists, sil-pac units which convert AC power into DC control power and all of the switchgear and transformers to reduce the power from 13,800 volts to working voltage for the hoists.

Systems that indirectly support the hoists were also completed in 1982. The HVAC (heating, ventilating and air conditioning) system which includes fans, air cleaners, evaporative cooler, ductwork, louvers and dampers was installed. Structural steel set in place consisted of guide support steel, guides for the skips, dump chutes, scroll plates, catch gear, arrestors, brattices, rope enclosures, monorail beams and monorail hoists. Three large monorail hoists (two 30-ton hoists for changing skip buckets and bails and a 20-ton hoist for installing the guideropes) and several other small monorail hoists to perform various tasks were installed.

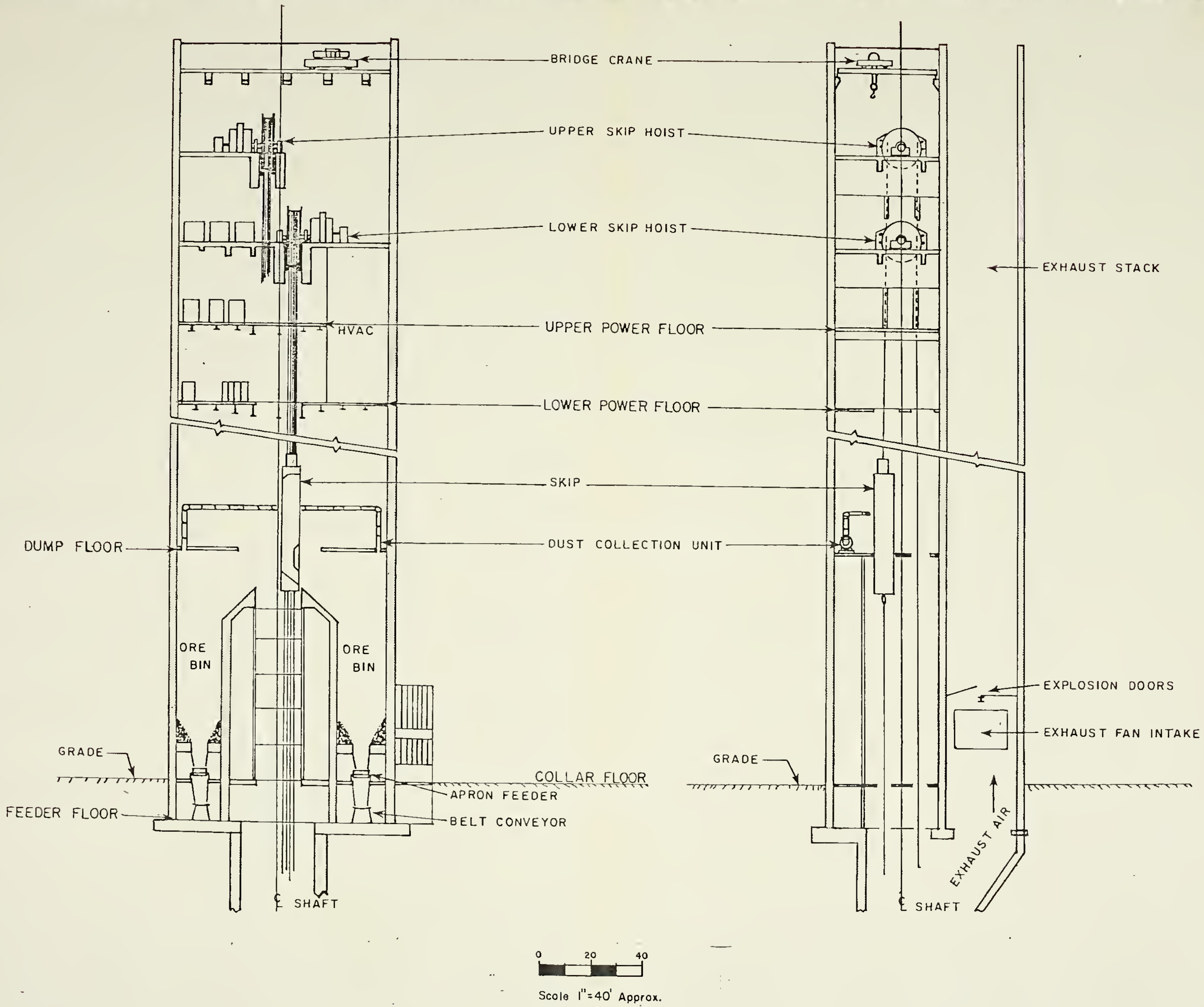


FIGURE 4-7

PRODUCTION HEADFRAME
VERTICAL SECTION

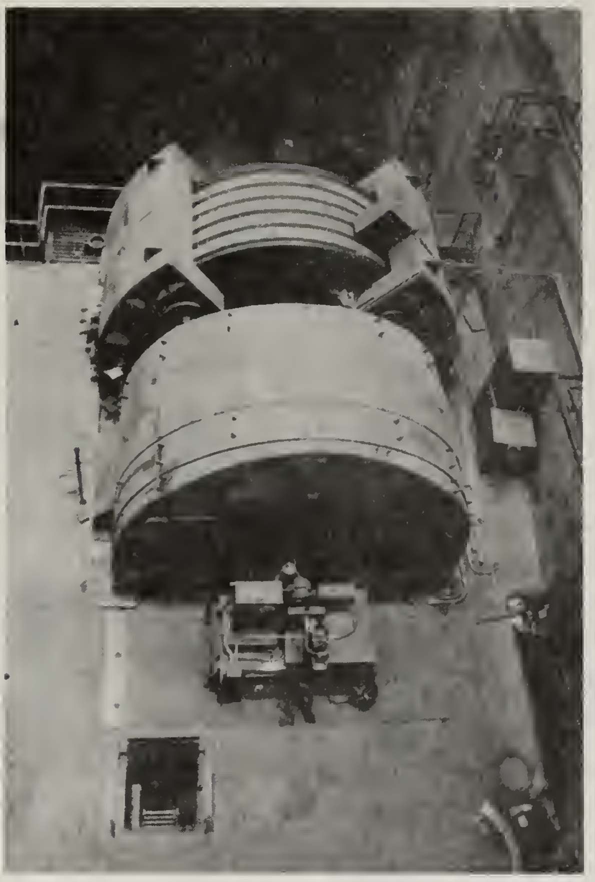


Figure 4-8
Upper Skip Hoist in Production Headframe

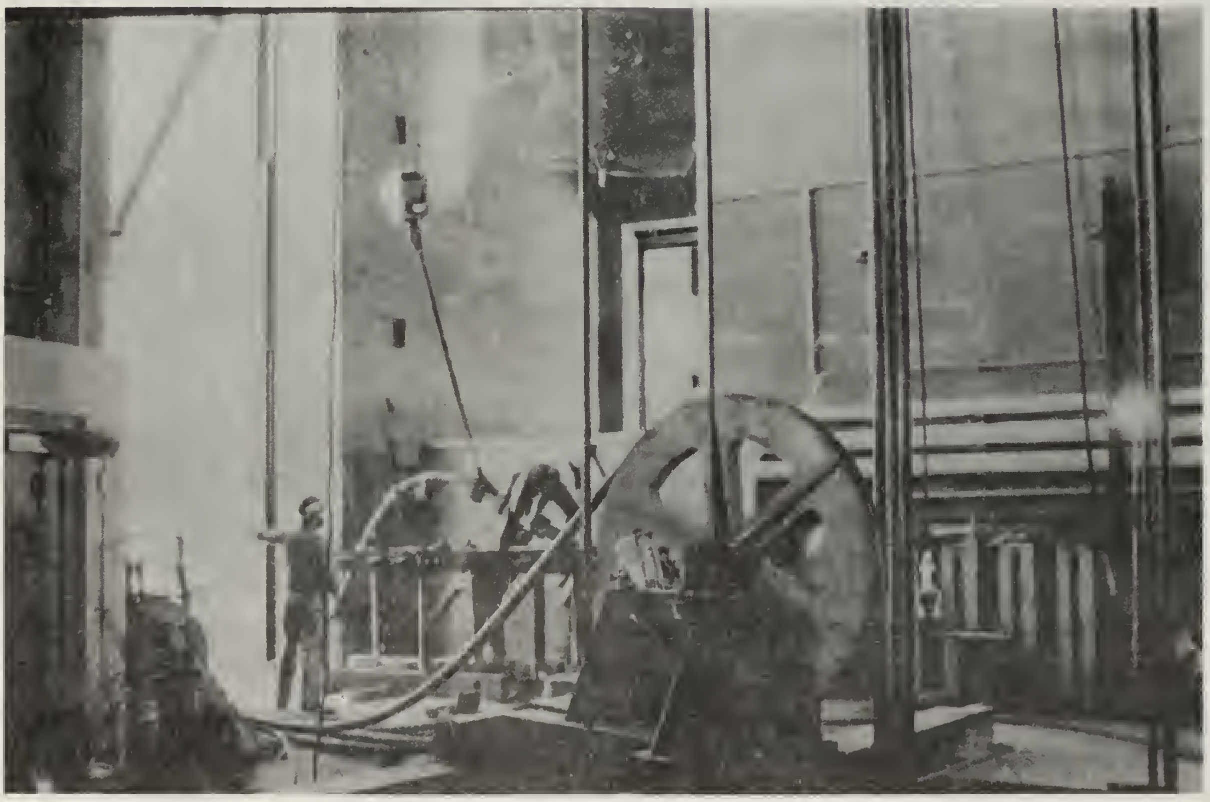
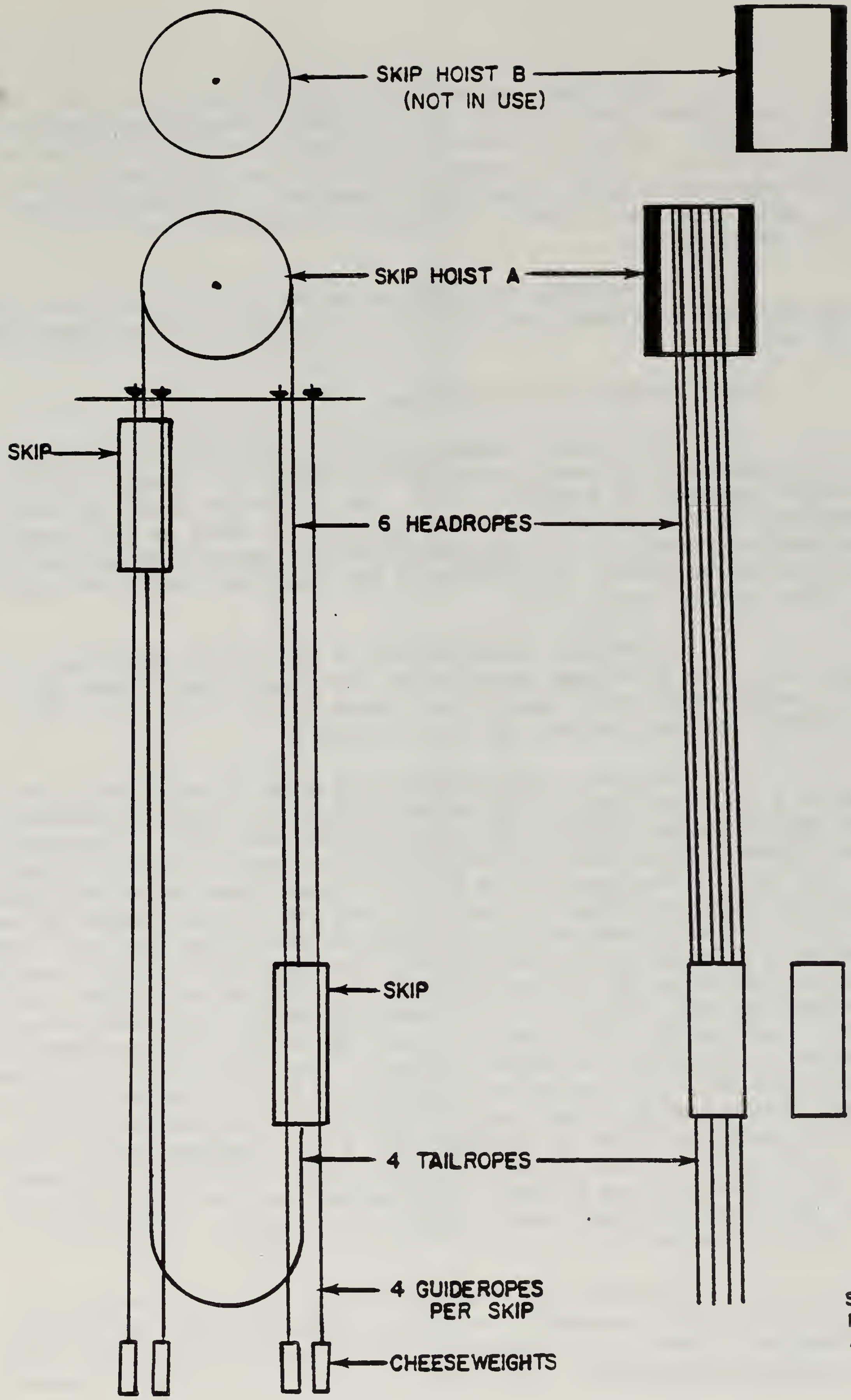


Figure 4-10
Production Headframe collar activity during rope-up of Skip Hoist "A"



SEE ALSO:
FIGURES 4-7
AND 4-24

FIGURE IV-9
PRODUCTION HOISTS-ROPE ARRANGEMENT

Additional systems were also finished during 1982 in the Production Headframe. Installation of a permanent elevator was completed on September 8, 1982. Vertical lift doors were installed over the large doorways on the collar level. A glycol heating system for the headframe was installed. Electrical equipment such as motor control centers, transformers, power panels, conduit, cable trays, and lighting fixtures was installed and miles of electrical cable pulled.

On December 22, 1982 the majority of the work for equipping the headframes was completed; the headframe contractor was then demobilized and moved off site.

4.1.3 Service Shaft Headframe

The 34-foot diameter Service Shaft will be used for hoisting both men and equipment and as a ventilation air intake. Construction of the shaft commenced in February, 1978. The collar and headframe foundations were completed at a depth of 65 feet in May. An air inlet or air tunnel to the Service Shaft was completed during August, 1978; it enters the Service Shaft some 100 feet below grade. Slipforming of the headframe tower took place in a 10-day period during August, 1978.

A vertical cross section of the Service Headframe is shown on Figure 4-11. The headframe contains the following floors (from top to bottom): hoist floor, upper power floor, lower power floor, collar floor (ground level), and manloading floor (below grade).

In April, 1981 construction began to equip the headframe to accommodate a full-scale mining operation. The installation of three-man and material hoists started late in 1981 and continued into 1982. The main cage hoist is a Koepe friction hoist built by Canadian General Electric (Figure 4-12). The hoist is equipped with a 1500 horsepower motor which develops a speed of 1500 feet per minute for materials and 800 feet per minute for men. Men and materials are transported underground by way of the main cage (Figure 4-13) which is balanced with counterweight. The cage has two decks capable of transporting 270 men or 30 tons of materials in a single trip. The cage and counterweight are hung from six 1-1/4" headropes and balanced with three 1-3/4" tailropes. The cage is guided down the shaft by four 1-3/4" guideropes with fixed guides on the collar and shaft stations. The counterweight is guided down shaft with two 1-3/4" guideropes (see Figure 4-14). The other two Service hoists are single-drum auxiliary hoists built by Bertram Nordberg (Figure 4-15). Each auxiliary hoist is equipped with a 300 horsepower motor which runs an auxiliary cage at a speed of 800 feet per minute. The auxiliary cages (Figure 4-16) are hung from a single 7/8" headrope and are guided the full length of the shaft on fixed timber guides. Each cage has a capacity of 15 men or 3000 pounds of materials.

The main cage hoist is similar to the skip hoists and contains the following components (in order of installation): sole plates, bearing pedestals, drum, shaft, armature, motorframe, brush assembly, brake engines, and auxiliary package (controls). The auxiliary hoists' components

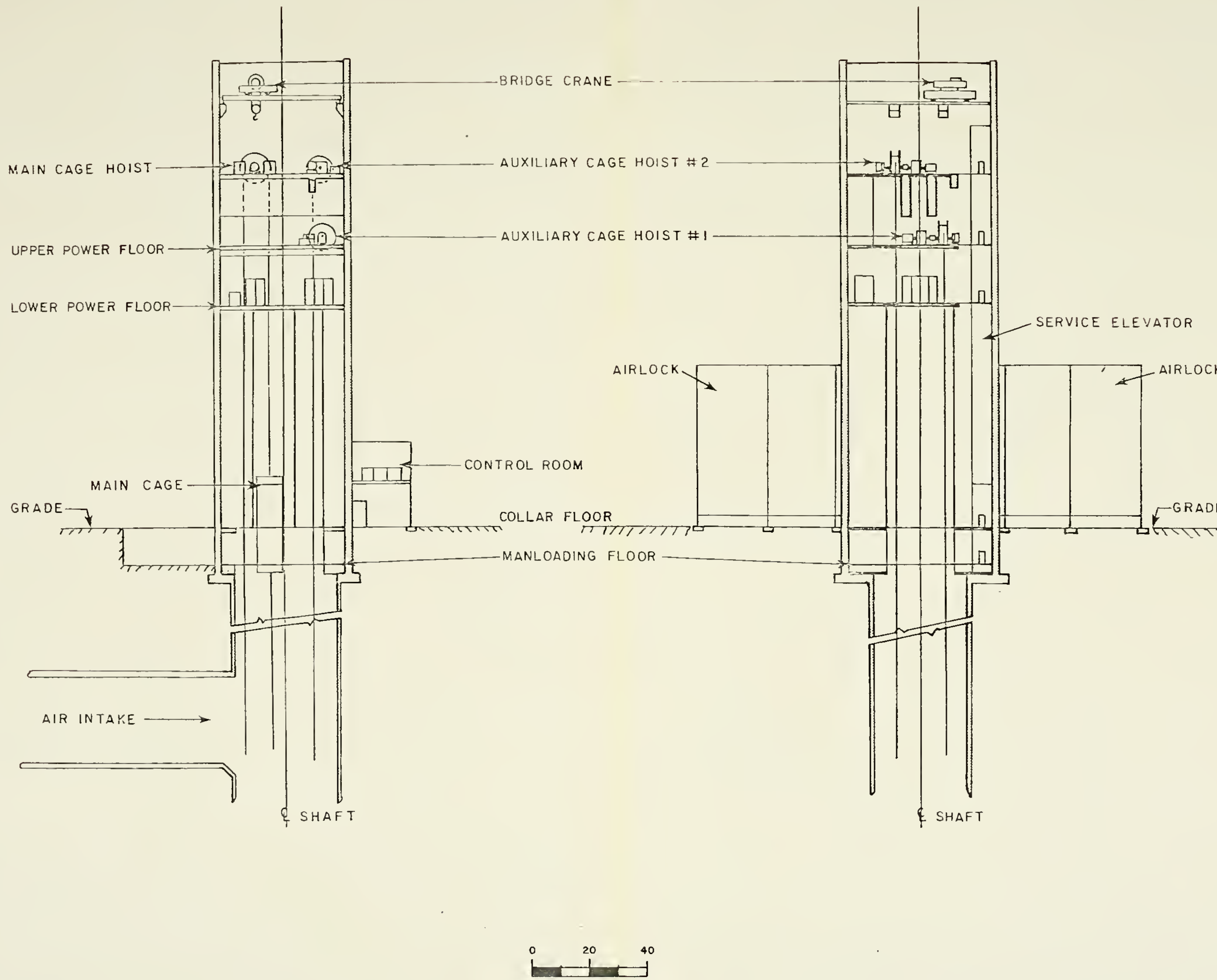
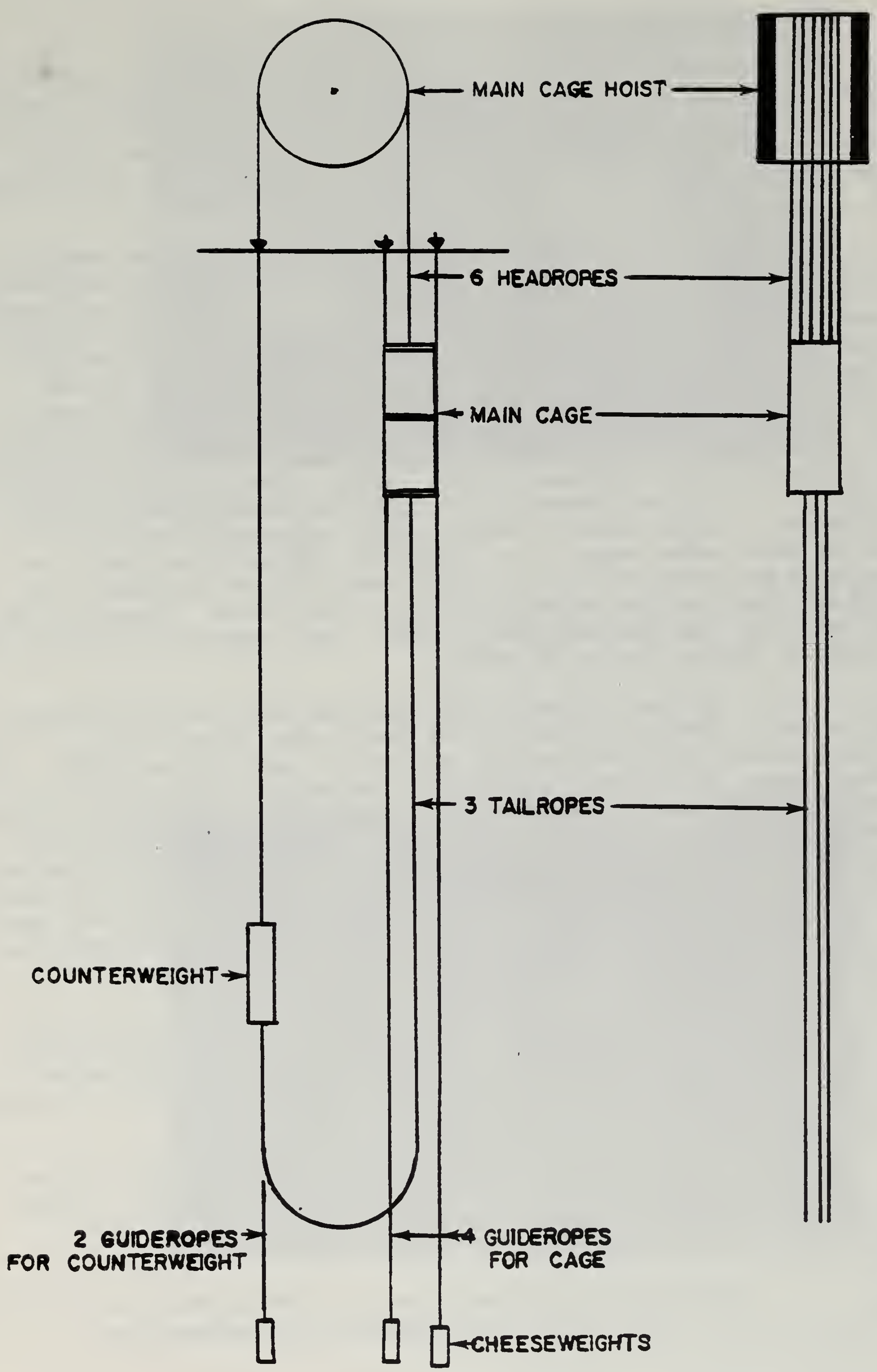


FIGURE 4-11

SERVICE HEADFRAME VERTICAL SECTION

Figure 4-12
Main Cage Hoist - Service Shaft

Figure 4-13
Main Cage on the Collar Floor
in the Steel Guide Structure



SEE ALSO:
FIGURES 4-11
AND 4-24

FIGURE 4-14
MAIN CAGE HOIST-ROPE ARRANGEMENT

include: sole plates, bearing pedestals, drum and shaft assembly, gear box, motor, brake units and auxiliary package. Each of these pieces was lifted 120 feet into the headframe by the 30-ton bridge crane. Mechanical erection of the hoists was completed at the end of 1981; but electrical connections of the hoists and controls and testing of the entire package remained to be completed in 1982.

The first hoist in the Service Headframe to be roped was the auxiliary cage hoist #2. This allowed men and material to be transported underground and allowed the shaft sinking contractor to remove the last sinking hoist from the Production Shaft. The sinking hoist was previously the only transportation to the shaft stations underground. Rope-up of auxiliary hoist #2 was completed February 15, 1982 and, after testing and inspection, was commissioned for use March 8. With this cage in use in the Service Shaft, pulling of control cables and installation of control boxes in shaft for the automatic operation of all hoists could start. Rope-up of the auxiliary cage hoist #1 followed and was completed July 20, 1982. Roping of the main cage hoist (Figure 4-17) did not commence until August but preparations started early in the year. Guide support, steel, guides, catchgear, arrestors, brattices and shaft gates needed to be installed. The main cage itself was erected outside the headframe (Figure 4-18), moved into the headframe with cranes and set into the fixed guides installed on the collar. Rope-up of the main cage hoist was completed September 6, 1982. Work required to automate all hoists continued through the end of 1982.

Attached to the Service Headframe are four new structures completed in 1982. These buildings are the Control Room (Figure 4-19), Mechanical/Electrical Rooms and the East and West Airlocks (Figure 4-20). The Control Room houses the control panels for all the hoists (Figure 4-21). It will eventually house the controls for main conveyor belts and feeders (surface and underground) and the Mine Monitoring System. The Mechanical/Electrical rooms include the manway and utility tunnels and all incoming services to the headframes and shafts, i.e. electrical power, compressed air, water, and steam lines for heating. The East and West Airlocks were constructed so that, when materials were being taken into the headframe, an airlock could be opened and closed without disturbing the ventilation system throughout the mine.

Systems in the headframe completed during the year that directly support the hoists include air compressors and piping to release the brakes on the hoists, sil-pac units which convert AC power into DC control power and all of the switchgear and transformers to reduce the power to working voltage for the hoists.

Other systems installed in 1982 include the HVAC system (heating, ventilating, and air conditioning), glycol heating system, vertical lift doors on the airlocks, a permanent elevator and electrical utility equipment.

The headframe contractor was demobilized December 22, 1982 when the majority of the work relative to equipping the headframes was

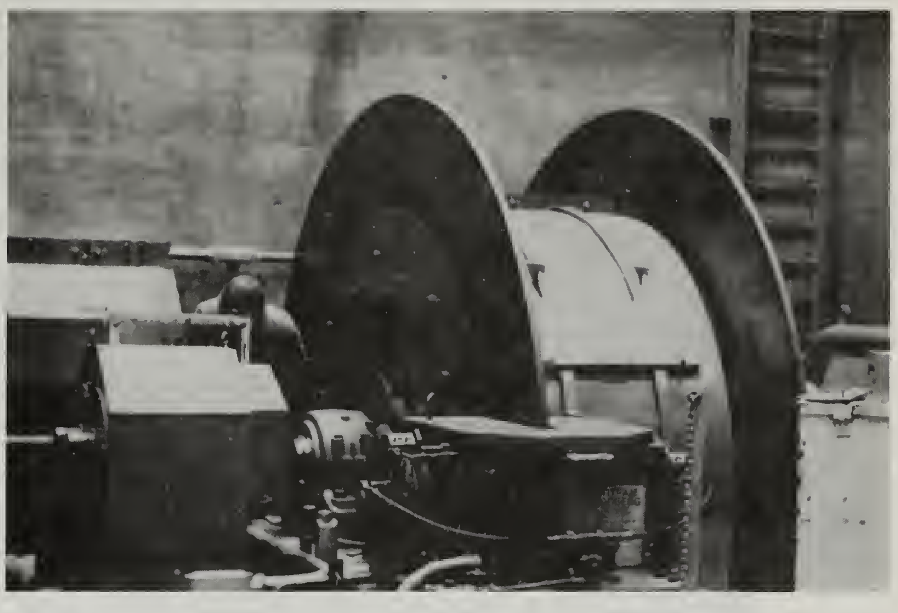


Figure 4-15
Auxiliary Hoist - Service Shaft

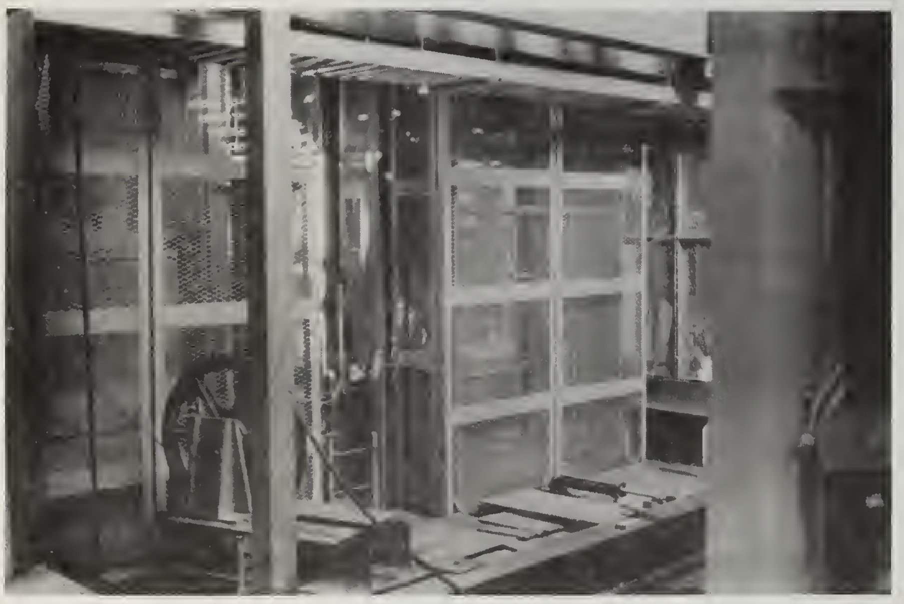


Figure 4-16
Auxiliary Cages - Service Shaft

Figure 4-17
Activity outside of Service Headframe during rope-up of Main Cage Hoist

Figure 4-18
Erection of the Main Cage Outside of the Service Headframe

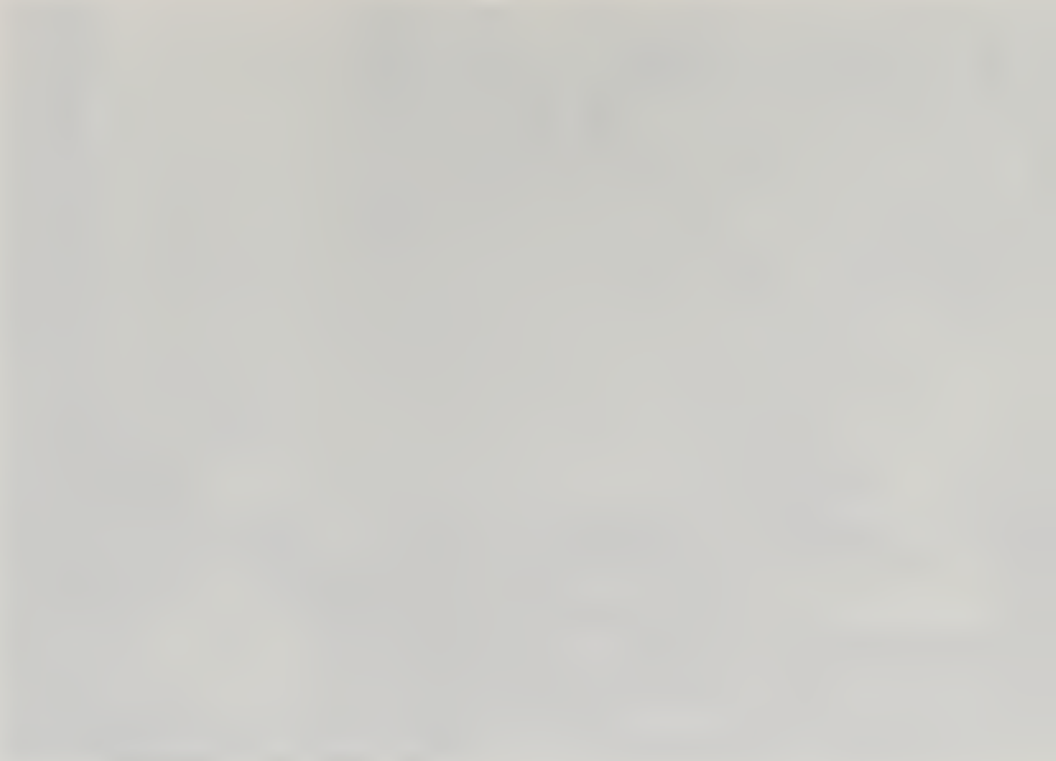


Figure 4-19
Exterior View of the Control Room

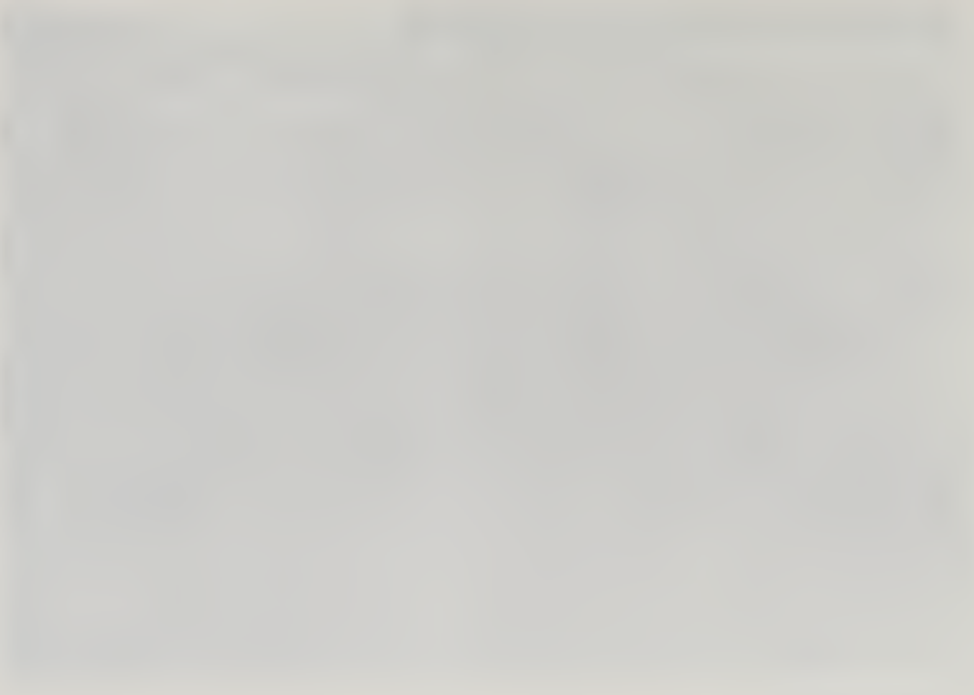
Figure 4-20
East Entrance to the Service Headframe East Airlock

Figure 4-21

Control Panel for all Hoists Located in the Temporary Control Room Attached to the Service Shaft Headframe.

Figure 4-22

Switchyard and Mine Support Area Substation



completed. Technical representatives of Canadian General Electric remain on site to complete testing and automation of all hoists.

4.1.4 Ventilation/Escape Shaft Headframe

Construction of the 15-foot diameter Ventilation/Escape (V/E) Shaft commenced in May, 1978. The collar and headframe foundations were completed and erection of a 147-foot steel headframe followed. Construction of the V/E hoist house and surface facilities started in July, 1978. The hoist house encloses a double drum hoist which was built by Nordberg, HVAC equipment, bridge crane, and electrical switchgear. Two surface buildings were also constructed to house the shop and dry facilities. Installations were completed in 1979.

No new construction on the V/E Shaft was started in 1982.

4.1.5 Electric Power and Switching Facilities

Primary power for shaft construction was provided by nine 1000 kw, 4160 volt, natural-gas-powered generators. Seven units were installed in 1979 with two additional units installed in 1980. Power distribution is by 13.8 kv overhead poleline to the shafts, batch plant, warehouse and office areas.

Site preparation for the switchyard and Mine Support Area Substation was initiated in July, 1980. High-voltage equipment was installed in Meeker and on the site by February, 1981, and in April erection of the Meeker-to-CB 138 kv powerline got underway; this line provides permanent power. Routing for this line was discussed in the 1980 report. The line was completed in October 1981. A building to house switchgear and transformers for the substation was constructed in 1981. Installation of electrical equipment continued into 1982 with the setting of switchgear and transformers and installation of conduit, cable tray and electrical cable. Following check-out and testing, the Mine Support Area Substation (Figure 4-22) was completed April 12, 1982. The Substation was energized with 138 kv power supplied by Colorado-Ute Electric that same day. Power from the Substation at 13.8 kv for site use was transmitted to the overhead poleline and the generators were shut down.

Five of the generators that were used to support the shaft sinking operation were removed by the contractor in 1982 and the four remaining generators were put on standby for emergency power.

Excavation for the utility tunnels from the Substation to the Service and Production Headframes began in July, 1981. Their location is shown on Figure 4-2. Precast concrete tunnels which would carry 13.8 kv and 4160 volt power lines from the Substation to the Service and Production Headframes were set in place, grouted and backfilled. The precast sections plus the poured concrete section at the Service Headframe were completed March 8, 1982. Following this, cable tray and electrical cables were installed in the tunnels to both headframes. Until this work was complete electrical power for

the headframes and shafts was fed temporarily from the overhead poleline. Permanent power to the Service Headframe and Shaft was energized June 9 and power to the Production Headframe was energized July 6, 1982.

4.1.6 Water Wells

Water for the Concrete Batch Plant operations and shower facilities was hauled via truck from the well (designated 24X25) on Piceance Creek. Potable water was hauled from Rifle. When operations were curtailed in 1982 the water haulage stopped. It is to be noted that water for sanitary facilities currently is supplied form the ponds and clearly labelled as non-potable. Bottled water is currently used for drinking purposes.

4.1.7 Office, Warehouse, and Shop Facilities

Buildings which were completed in 1982 are listed in Table 4-2 along with descriptions as to use, size and location. Facilities added to the Service Shaft Headframe include Control Room, East and West Airlocks and Mechanical/Electrical Room. Existing facilities are shown on Figures 4-1 (jacket map), 4-2 through 4-6 and the facilities key (Table 4-1).

4.1.8 Concrete Batch Plant

The Concrete Batch Plant produced 800 cubic yards of concrete during 1982 for on-Tract use. Bulk cement, sand, and aggregate mixtures are transported to the site by truck from Rifle or Meeker and stored in a special building. Water for the batch plant operation is hauled from the well on Piceance Creek (24X25). Winterization of the batch plant was completed in 1981. This work included installation of doors and heaters on the Sand/Aggregate Storage Building. The batch plant was shut down in March, 1982.

4.1.9 Explosives Storage and Use

The explosives storage (powder magazine) area is, as shown on Figure 4-6, remotely located from areas of major activity. Mining was completed in 1981 and no explosives were used or stored there in 1982.

4.1.10 Water Treatment Facilities

The surface water facility is designed to handle water produced in dewatering the mine for project development use. This is accomplished by discharge to surface tributaries of Piceance Creek from the lower ponds (A & B) or by sprinkler irrigation or to a subsurface reinjection system from upper pond C to inject any surplus water or water that may in the future be required for augmentation of depletions of senior water right holders supplies. The system was initiated in 1979 for direct discharge from Ponds A & B into Little Gardenhire Gulch. In 1980 the sprinkler system was completed, tested and used throughout the summer. It was again in use during the summer of 1981. The sprinkler irrigation system consists of a lateral distribution system on the ridge between Cottonwood and Sorghum Gulches as shown in the 1980

Annual Report. Reinjection tests commenced in March of 1981. After this test period of about sixty days the reinjection system was in almost constant use through June 1982, except during July and part of August of 1981, when needed repairs and modifications were made to the system. Since July of 1982 when mine dewatering was reduced, the reinjection mode has been temporarily discontinued primarily to effect a cost savings, and direct surface discharge of treated mine water has been utilized.

The pH is monitored at the overflow between Ponds A & B by a continous pH meter. The pH of the mine water is adjusted when necessary to ≤ 9 at Ponds A & B by the addition of sulfuric acid. A storage tank and associated piping deliver acid as needed to lower the pH of the water at each pond. Grab samples are taken at other points in the ponds to assure that proper control of the pH is being maintained in the range from 6 to 9.

Suspended solids are settled out in Ponds A & B when necessary with addition of polymer flocculents. Nalco #8852 or Magnifloc #573-C have been used with great success. This system consists of two 500 gallon mixing tanks and metering pumps which feed Ponds A & B. Settled solids have been periodically cleaned from the ponds and placed in the mine-run material pile east of the Production Shaft Headframe.

The reinjection water treatment facility was tested and put into operation in 1981. Water from Pond B is pumped to Pond C and then flows through the L'eau Claire upflow sand filter. The filter lowers the turbidity to below 1 ntu. The filtered water is then pressurized with a centrifugal pump and rejected into Well 11X18. Two other rejection wells have been drilled, 22X17 and 24X17, and when completed, are available for addition to the reinjection system.

A total of 291 million gallons was pumped from the shafts in 1982, compared to 634 million gallons in 1981. Its deposition and use by month is given in Table 4-3. Flow metering of the NPDES discharge has been accurate to approximately 5-10%. For the years 1981 and 1982 the overall summary is:

	(10^6 gallons)	
	1981	1982
Total water pumped from shafts	634	291
Water used, evaporated, etc.	164	30
Water treated		
NPDES surface discharge	331	134
Reinjected	99	127
Sprinkler irrigated	40	0
Total treated	470	261

Further water management aspects are discussed in Section 7.2.

TABLE 4-3

1982 C-B WATER USAGE (10**6 GALLONS, * =ACRE FEET)

	USE	SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL YTD	TOTAL YRS TD
ALL SHAFTS	GLAND WTR	PUMP STA	5.46	2.29	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	7.75	190.6
			16.76*	7.03*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	23.79*	584.9*
*TOTAL ALL SHAFTS			5.46	2.29	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	7.75	190.6
			16.76*	7.03*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	23.79*	584.9*
OFF-TRACT WTR USED	POTABLE	TOWN	.03	.02	.02	.02	.02	.02	.02	.01	.01	.01	.01	.01	.21	1.1
			0.08*	0.07*	0.07*	0.07*	0.07*	0.07*	0.06*	0.03*	0.03*	0.03*	0.03*	0.03*	.63*	3.3*
*TOTAL OFF-TRACT WTR USED			.03	.02	.02	.02	.02	.02	.02	.01	.01	.01	.01	.01	.21	1.1
			0.08*	0.07*	0.07*	0.07*	0.07*	0.07*	0.06*	0.03*	0.03*	0.03*	0.03*	0.03*	.63*	3.3*
TRACT WATER USED	BATCH PLNT	24X-25	.03	.01	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.07	2.5
			0.08*	0.02*	0.04*	0.05*	0.02*	0.01*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	.21*	7.6*
	CONSTR	PONDS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		18.0
			0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*		55.1*
	CONSTR	24X25	.05	.01	.05	.02	.04	.04	.05	.08	.00	.00	.00	.00	.33	1.7
			0.14*	0.04*	0.15*	0.06*	0.11*	0.12*	0.14*	0.23*	0.00*	0.00*	0.00*	0.00*	1.01*	5.1*
	DUST CNTL	PONDS	.00	.00	.02	.02	.05	.03	.07	.00	.00	.00	.00	.00	.18	6.6
			0.00*	0.00*	0.05*	0.06*	0.14*	0.10*	0.20*	0.00*	0.00*	0.00*	0.00*	0.00*	.56*	20.4*
	EVP & LEAK	POND C	7.78	7.19	6.64	6.29	8.76	3.52	.60	.10	.10	.10	.10	.00	41.18	144.6
			23.86*	22.06*	20.36*	19.31*	26.89*	10.80*	1.84*	0.31*	0.31*	0.31*	0.31*	0.00*	126.35*	443.8*
	NPDES REL	PONDS	.00	.19	.00	.00	.00	.00	24.09	24.09	22.70	21.06	19.78	22.07	133.98	788.7
			0.00*	0.58*	0.00*	0.00*	0.00*	0.00*	73.92*	73.92*	69.65*	64.62*	60.70*	67.74*	411.12*	2,419.9*
	REINJECT	PONDS	21.56	19.85	19.88	17.95	25.72	21.83	.00	.00	.00	.00	.00	.00	126.78	225.7
			66.16*	60.90*	60.99*	55.09*	78.91*	66.98*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	389.02*	692.6*
	SPR IRRIG	POND C	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		79.1
			0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*		242.6*
*TOTAL TRACT WATER USED			29.41	27.25	26.59	24.30	34.57	25.42	24.80	24.26	22.80	21.16	19.88	22.07	302.53	1,266.8
			90.24*	83.60*	81.60*	74.57*	106.06*	78.01*	76.10*	74.46*	69.96*	64.93*	61.01*	67.74*	928.28*	3,887.1*
WATER IN STORAGE	-	POND A	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.00	1.00	1.00	1.00	1.00		
			4.60*	4.60*	4.60*	4.60*	4.60*	4.60*	3.07*	3.07*	3.07*	3.07*	3.07*	3.07*		
	-	POND B	1.30	1.40	1.50	.70	.70	1.50	.15	.15	.15	.15	.15	.15		
			3.99*	4.30*	4.60*	2.15*	2.15*	4.60*	0.46*	0.46*	0.46*	0.46*	0.46*	0.46*		
	-	POND C	1.30	1.40	1.20	1.40	1.40	1.20	.60	.50	.40	.30	.20	.20		
			3.99*	4.30*	3.68*	4.30*	4.30*	3.68*	1.84*	1.53*	1.23*	0.92*	0.61*	0.61*		
*TOTAL WATER IN STORAGE			4.10	4.30	4.20	3.60	3.60	4.20	1.75	1.65	1.55	1.45	1.35	1.35		
			12.58*	13.19*	12.89*	11.05*	11.05*	12.89*	5.37*	5.06*	4.76*	4.45*	4.14*	4.14*		
WATER PUMPED	-	33X-1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		4.3
			0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*		13.3*
	-	24X-25	.07	.02	.06	.04	.04	.04	.05	.08	.00	.00	.00	.00	.39	7.9
			0.22*	0.06*	0.18*	0.11*	0.13*	0.13*	0.14*	0.23*	0.00*	0.00*	0.00*	0.00*	1.21*	24.4*
	-	32X-12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		5.9
			0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*		18.0*
	-	V/E SHAFT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		678.9
			0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*		2,083.1*
	-	PROD & SERV	29.55	26.21	23.84	20.54	29.55	25.38	24.95	25.00	22.98	21.06	19.86	21.72	290.65	813.0
			90.68*	80.43*	73.16*	63.02*	90.67*	77.88*	76.55*	76.70*	70.53*	64.62*	60.95*	66.65*	891.83*	2,494.8*
*TOTAL WATER PUMPED			29.62	26.23	23.90	20.57	29.59	25.42	25.00	25.07	22.98	21.06	19.86	21.72	291.04	1,510.1
			90.90*	80.50*	73.33*	63.13*	90.80*	78.01*	76.70*	76.93*	70.53*	64.62*	60.95*	66.65*	893.04*	4,633.5*

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4.1.11 Hydrology Laboratory

This lab is equipped with all the necessary laboratory and safety equipment and supplies to ensure the proper preparation and testing of field water samples: pH, temperature, conductivity, dissolved oxygen, total suspended solids and fluoride. Samples for additional water quality parameter determination are labeled, preserved and transported to Cathedral Bluffs' Grand Junction Laboratory for analysis or shipment to a commercial laboratory.

4.1.12 Off-Tract Engineering Studies

Union Oil of California:

Approximately 55 tons of C-b Tract shale were processed in Union Oil Company's Unishale B Pilot Retort in California.

Bechtel:

Bechtel, San Francisco, under contract to Cathedral Bluffs, performed engineering work that resulted in the preparation of a "Process Design Package and Cost Estimate for MIS Underground and Aboveground Process Facilities".

Bechtel Canada Limited prepared the "Crushing and Screening Testwork Report". This report outlined the test results of crushing and screening testwork performed on C-b Tract shale.

Brown and Caldwell:

Brown and Caldwell of Walnut Creek, California, prepared the final report on the "Treatability Studies of Off-gas Condensate from Modified In Situ Oil Shale Retort Operation".

Cathedral Bluffs:

1. Cathedral Bluffs developed the process design and prepared cost estimates in-house for the mine and Surface Process Facilities which resulted in the definition of "First Case" CB Project producing approximately 4-5 million barrels annually. This package was developed to evaluate the aboveground retorting technology to be used at CB.

2. Cathedral Bluffs developed an engineering package which included the process design and in-house cost estimates for the mine, aboveground retorting facilities, oil upgrading facilities, and other project support facilities. This package was submitted to Synthetic Fuels Corporation as part of the applications for financial assistance.

4.1.13 Permanent Mine Support Buildings

Construction of new mine support buildings in 1982 consisted of the Control Room, Mechanical/Electrical Rooms and the East and West Airlocks. These buildings are attached to the Service Headframe and three of the four are part of the headframe operation. The East and West Airlocks

assist in controlling ventilation in the mine. Construction of the airlocks, as with all of these buildings, started in late 1981 with excavation work and footings being poured. Concrete work for both airlocks was completed in February and the steel framework and insulated siding were completed on the airlocks in July. The Mechanical/Electrical Rooms are located on the south side of the Headframe on the subcollar level. These rooms house the utilities for the Headframe which are fed from the utility tunnel. Concrete work was completed in March and placing of equipment was completed in September. The temporary Control Room on the north side of the Headframe houses the controls for both the Production and Service Shaft hoists. Construction of the building was completed in May and installation of the equipment completed in November, 1982.

4.2 Off-Tract Facilities Description

4.2.1 Grand Junction Office

The Headquarters Facility at 751 Horizon Court in Grand Junction has been in continuous use since January of 1979. Because of overcrowding, the Accounting and Health, Safety, and Security Departments moved to the Crossroads Business Commons Building at 2764 Compass Drive (approximately one-half mile to the north of the Headquarters Facility) on May 1, 1981; with staff consolidation in 1982, they relocated back to the Headquarters Facility on August 1, 1982. Also in 1982 consolidation of Occidental and Tenneco staffs on the CB project at this facility was completed.

4.2.2 Occidental Oil Shale Laboratory

The Occidental Oil Shale Laboratory at 2372 G Road is responsible for analyzing the various special and routine samples received from the Cathedral Bluffs site. The Laboratory must be responsive to high priority and rush samples, giving short turn-around times for results. Routine NPDES samples are analyzed and reported within 3 to 4 weeks of receipt. The Laboratory has a stringent quality control program and high standards of accuracy and precision.

4.2.3 Rifle Warehouse and Rail Siding

Forty acres were purchased west of Rifle for future rail siding, staging area, and product shipment. The project has used a rail siding at the Rifle railroad station for off loading bulk materials and equipment for construction.

4.2.4 Rifle Parking Lot

The employee parking lot located behind the Rifle Gap Apartment units was paved and striped in 1981. The lot can now accommodate about 340 vehicles. No new work was started in 1982.

4.2.5 Utility Corridors

The first stage of the electric power supply system for the project was completed in late 1981. This consists of a single 138,000 volt, 22-mile transmission line from Meeker to the CB site. The routing was discussed in the 1980 report. The power line attaches to a 30,000 KVA transformer at the Mine Support substation. Power was applied to the power line/substation in late December 1981 for testing purposes. The transmission line and Mine Support Area Substation were energized April 12, 1982.

4.3 Access/Service/Support/Activities

4.3.1 Roads and Guard Rails

No new road work was done in 1982.

4.3.2 Truck Weighing Facility

Truck weigh scales were put into service in 1981, primarily to weigh truckloads of sand, aggregate, and cement that were received on Tract. These scales have the capability of weighing up to 60 tons gross weight. This facility (#45) is located on Figure 4-4.

4.3.3 Fuel Storage and Dispensing

The Fuel Dispensing Facility, which is computer controlled, was put into service in 1981. It is designated as facility #16 on Figure 4-2. Diesel as well as gasoline storage tanks are connected to the system. Liquid petroleum gas storage tanks are also on site to provide gas for heating the site buildings and facilities. Fuel consumption during the year was 115,400 gallons of diesel, 66,240 gallons of gasoline, 151,520 gallons of L.P.G., and 64,950,000 cu.ft. of natural gas as indicated on Table 4-4.

4.3.4 Sewage Treatment Facility

A 9,000 gpd packaged Sewage Treatment Plant located on Figure 4-4 was placed into service in 1981. This plant is an activated sludge type plant, manufactured by Environmental Conditioners, Inc. Raw sewage was hauled by truck to the plant from holding tanks at the dry houses. A total of 180,330 gallons of sewage water was treated in 1982. The facility was shut down in October, 1982.

4.3.5 Gland Seal Water System

Water for the dewatering-pump gland-seal system in the Production and Service Shafts was supplied by pumps located at the lower-pond pump house and piped to the shafts. Clean water is supplied for pump gland seals from Pond B, where the suspended solids have been removed through settling. Average supply to the pump gland-seal system was 92 gpm at the Production and Service Shafts during 1982. The gland-seal water system was shut down March 1, 1982 inasmuch as suspended solids in the mine water decreased sufficiently in 1982 upon termination of shaft sinking.

TABLE 4-4

1982 CR Consumable Usage

	USE	UNITS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL YTD	TOTAL YRS TD
Wtr Treatment-Acid	Ponds A&B	10**3 Gal	.74	.82	.49	1.65	.98	1.14	.16	.16	.00	.00	.00	.00	6.16	115.97
Diesel Fuel #1	-	10**3 Gal	.07	.00	.00	.00	14.58	.01	.00	.00	.00	.00	.00	.00	14.67	69.01
Diesel Fuel #2	-	10**3 Gal	20.89	15.91	18.31	16.35	.20	17.24	3.54	1.79	3.25	1.70	.24	1.30	100.73	439.56
Gasoline	-	10**3 Gal	11.34	8.05	6.83	6.05	5.07	4.53	4.27	4.49	3.79	4.39	3.76	3.64	66.24	279.36
Propane	-	10**3 Gal	10.23	42.05	16.41	15.23	10.75	.20	2.25	.00	.00	5.00	23.50	25.89	151.52	367.80
Natural Gas	-	10**3 MCF	19.47	18.70	16.42	10.35	.00	.00	.00	.00	.00	.00	.00	.00	64.95	785.96
Dust Palliative	-	10**3 Gal	.00	.00	.00	.00	.00	1.00	2.00	2.00	.00	.00	.00	.00	5.00	24.97
Mined Shale	-	10**3 Cu Yd	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		114.67
Mined Shaft Rock	-	10**3 Cu Yd	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		11.40
Explosives	-	10**3 Lbs	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		327.02
Explosives Freq.	-	10**3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		1.52
Disturbed Acreage	-	Acres	188.00	188.00	188.00	188.00	188.00	188.00	188.00	188.00	188.00	188.00	188.00	188.00		188.00
Flocculant	-	10**3 Gal	.01	.01	.02	.02	.02	.03	.00	.00	.00	.00	.00	.00	.12	1.55

4.3.6 Fire Water Loop System

As Utility Tunnels were installed in 1981 (Figure 4-2) piping for the Fire Water Loop System was installed adjacent to them. A hydrant was located at the Mine Area Substation, lines were run to the Service and Production Headframes, and to the Changehouse/Operations Building via the Manway and Utility Tunnels. No new work was started in 1982.

4.3.7 Pipelines

Natural gas lines were installed adjacent to the Utility Tunnels in 1981. A line between the Production Shaft and the proposed Boiler/ Compressor Building was connected to another line that ran between the Production and Service Shafts. This line then ran adjacent to the Manway and Utility Tunnels to the Changehouse/Operations Building.

4.3.8 Communications

With the exception of additional extensions to the present PBX system, no new telephone installations were made during the year.

4.3.9 Helicopter Pad

Scheduled helicopter passenger service between Logan Wash, Grand Junction and CB was suspended in 1982. The heliport is still maintained to provide emergency medical transportation, when needed, and for future use.

4.3.10 Aerial Survey

No aerial survey was done for the C-b Tract in 1982.

4.3.11 Surface Mobile Equipment

Roadways were sprayed with water on an as-needed basis (usually daily) during the summer months. Dust suppressant (Coherex/water mix) was applied on a scheduled basis or as conditions dictated. A road grader maintained the road surface, and loaders and trucks were used on an as-needed basis to clean ditches, culverts, etc. Snow removal and road-sanding crews were on call for road maintenance during winter months.

4.3.12 Consumables Usage

Monthly water reports to the Colorado State Engineer include the water data depicted on Table 4-3: water pumped from the shafts, water used, treated (discharged, sprinkled or reinjected), and water stored. In addition to these data, quarterly reports to the EPA under the existing Prevention-of-Significant-Deterioration permit report the information on Table 4-4 for additional consumables: fuels, acid and flocculants, dust palliatives, shaft rock and shale mined, explosives used, and disturbed acreage. Yearly-totals and cumulative-yearly-totals are also given in the tables.

4.4 Mining

In 1981, the Production Shaft, the Service Shaft, and the Ventilation/Escape Shaft reached design depth. Sinking employed conventional drill, blast, muck-out, and concrete lining techniques. Multiple small drill holes (1-1/2" diameter) were drilled in approximately 8-foot lengths, filled with explosives, blasted, and mucked-out. This sequence was then repeated. After each successive 25 feet of shaft was sunk, it was then lined with concrete.

Installation of steel in the Production Shaft continued into 1982. Shaft steel installation in the Service and V/E Shafts was completed in 1981. The V/E Shaft dewatering was terminated and the shaft allowed to flood as of September 1981 so as to reduce the volume of discharge from Pond B to Piceance Creek.

4.4.1 Production Shaft

Excavation and concrete lining of the Production Shaft was completed to the final depth of 1,867 feet (elevation 4,962) in September, 1981. Installation of the steel on the Lower Level and in the loading pocket was nearly complete and continued into 1982. See Figure 4-23 for a view of the Production Shaft at the Lower Void Level.

Following the completion of the steel installation, the loading pocket ventilation system was set up. The shaft sinking galloway was modified so that the sinking utilities could be removed and permanent utilities relocated while the galloway was being raised to the surface. Installation of steel at the mid-shaft level was also completed at this time. The sinking galloway was removed and the hoist used to lower the east skip bails into their positions for roping-up. After this was completed, the sinking hoists were removed and the sheave deck was dismantled.

4.4.2 Service Shaft

The 34-foot-diameter Service Shaft reached a design depth of 1,765 feet (elevation 5,064) below the collar April 30, 1981. Steel installation in the shaft was completed in September, 1981, leaving only miscellaneous installations for 1982. This included installation of new power cables from the surface, installing the hydraulic system for the mid-shaft sliding platform, minor modifications to the shaft steel in the auxiliary #2 compartment, and clean up of the shaft stations. Water produced at the end of 1982 for both the Production and Service Shafts was 480 gpm with a yearly average of 554 gpm; corresponding values for the previous year were 761 gpm and 718 gpm respectively.

4.4.3 Ventilation/Escape Shaft

Shaft sinking for the 15-foot diameter Ventilation/Escape Shaft attained a final depth of 1,617 feet (elevation 5,080) in July, 1981. The shaft was allowed to flood in 1981 as a temporary measure to conserve and reduce surplus discharge to the surface. Water level in the shaft remained

Figure 4-23
Production Shaft - Lower Void Level

fairly constant through 1982 at an elevation of 6,310 feet; 395 feet below the collar.

4.4.4 Production/Service Shaft Station Development

Stations on all levels are complete and interconnect on five levels between the Production and Service Shafts. The majority of the drifting is 20-feet high and 30-feet wide with smaller drifts for sumps and water collection areas. These stations are as follows:

Collar Level	(elevation 6,829)
Midshaft Level	(elevation 6,095)
Air Level	(elevation 5,644)
Upper Level	(elevation 5,481)
Intermediate Level	(elevation 5,340)
Lower Level	(elevation 5,203)
Bottom Level	(elevation 4,973) (Production Shaft Drift Only)

These stations are shown on the isometric sketch on Figure 4-24. No new station development was started in 1982. See Figures 4-25 to 4-28 for photographs at the Lower, Mid-Shaft, and Upper Void Levels.

4.4.5 Mine Ventilation

As noted in the 1980 report, the shafts were classified as gassy by MSHA on January 2, 1980. The ventilation system has been designed to comply with gassy mine regulations and conditions. Gas monitoring is discussed in Section 7.7.4. See Figure 4-27 for installation of the Gas Monitoring System.

The Service Shaft is equipped with a 75 hp blower fan plus propane-fired air intake heater at the surface. At the Intermediate Level in the shaft, twin 50 hp suction fans connected to a 36-inch ventilation tube move the air from the bottom of the Service Shaft and exhaust it up the Production Shaft. Also at the Lower Void Level in the Production Shaft, twin 50 hp suction fans connected to a 36-inch ventilation tube blow air to the bottom of the Production Shaft and exhaust it up that shaft.

As the V/E Shaft filled with water, down-shaft ventilation was maintained. Methane readings have been zero so that the fans have been shut off with the shaft open. Access to the shaft area is restricted.

Figure 4-24

SERVICE AND PRODUCTION SHAFT WORKINGS

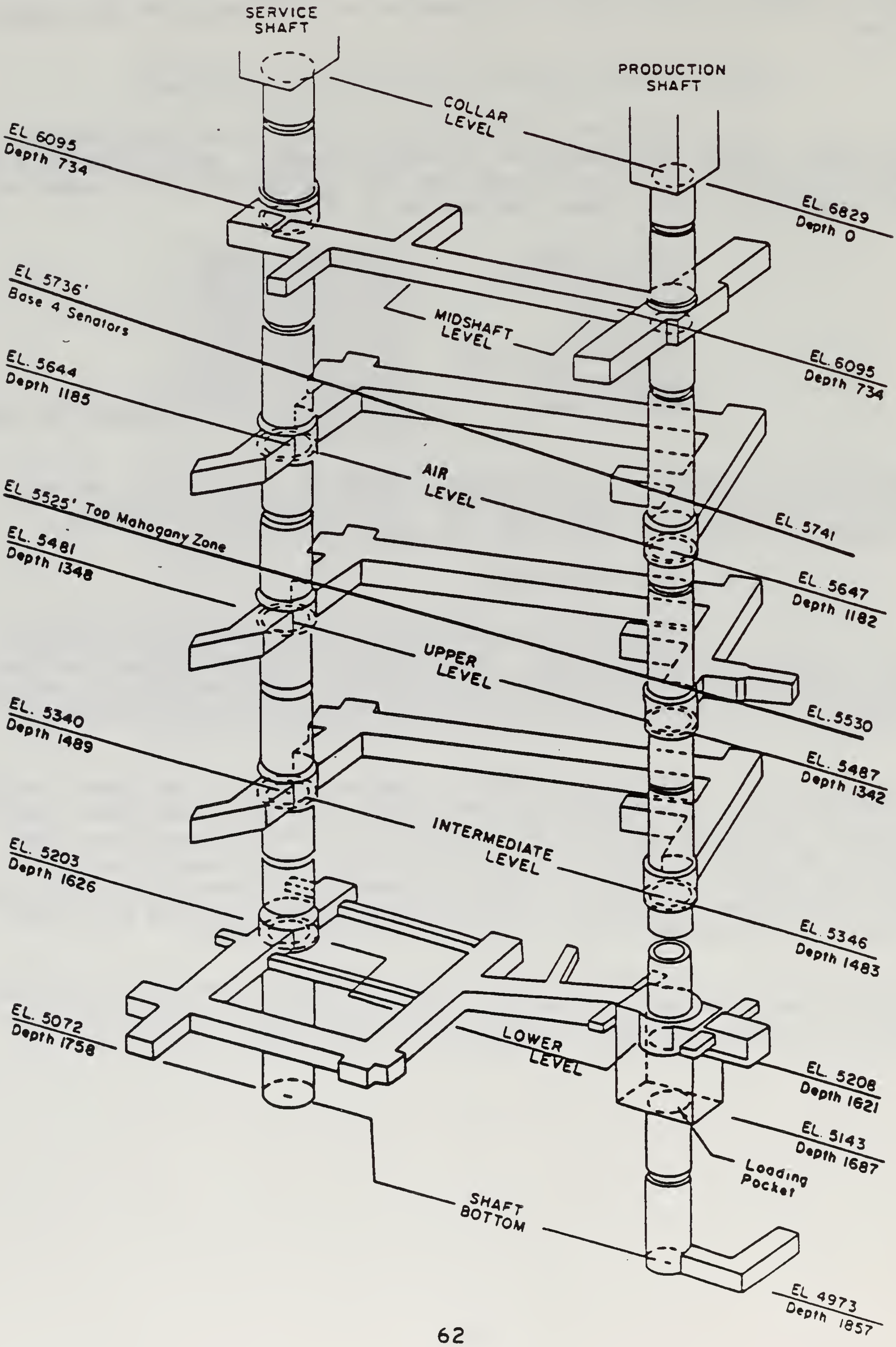


Figure 4-25
Lower Void Level Pump Station

Figure 4-26
Mid-Shaft Level Pump Station

Figure 4-27
Installing Gas Monitoring System
Upper Void Level

Figure 4-28
Pump Station - Upper Void Level

5.0 PROCESSING

No shale oil processing facilities exist on the C-b Tract. Engineering studies related to processing are discussed in Section 4.1.12.

Approximately 50 tons of raw shale were transported to Union's retorting facility in California for a retorting test in 1982.

6.0 DISTURBED AND RECLAIMED AREAS

Areas of disturbance through 1982 and the corresponding acreages are listed in Table 6-1 and shown on Figure 6-1 (jacket map).

6.1 Disturbed and Reclaimed Areas

There were no new disturbed areas during 1982. The total number of acres disturbed to date remained the same for 1982 as for 1981, 188 acres.

The areas reclaimed in 1982 were two drill pads (32Y-12 and 21X-12, one acre each) and a temporary laydown area near Pond C (less than one-half acre). The drill pad for corehole 21X-12 was disturbed in 1981 and erroneously reported as being reclaimed in last year's report (therefore no adjustment in total acreage reclaimed). The drill pad for monitoring well 32Y-12 was disturbed previously, as part of the raw shale embankment. The well was drilled in 1981, the drill pad seeded with a temporary seed mix, and was fully reclaimed in the fall of 1982. The one acre of drill pad 32Y-12 reclaimed brings the total number of acres reclaimed to date to 35.

During 1982 there were some miscellaneous areas which were temporarily reclaimed. (Some areas received limited regrading and all areas were seeded with the temporary seed mix of Table 6-2.) Included in these miscellaeous areas are: berms, slopes and some graded areas of the Mine Support Area; the 12 acre borrow area, berms and graded areas around Pond C; and three new erosion control structures. These areas are not considered as reclaimed, or revegetated.

6.2 Overburden Storage

No overburden was mined during 1982.

6.3 Shale Storage

No raw shale was mined during 1982.

6.4 Reclamation/Revegetation Status and Control

6.4.1 Backfill

There was no change in backfill areas during 1982.

6.4.2 Graded Lands

The acreages in graded condition remained the same in 1982, despite some areas which were seeded with the temporary seed mix (used as an additional stabilization measure).

6.4.3 Topsoil Replacement

Topsoil was replaced on the two drill pads mentioned previously.

TABLE 6-1

Estimates of Acreages Disturbed, Revegetated, and Permitted for Disturbance

Area[1]	Acreages Disturbed Before 1982	Acreages Disturbed During 1982	Acreages Revegetated Before 1982	Acreages Revegetated During 1982	Acreages Permitted But Not Disturbed
1) Guard House & Truck Scale Area	2				
2) Sewage Treatment Plant & Road	2				
3) Heliport & P. R. Trailer	1				
4) Main Access Road	24				
5) V/E Shaft Area	14				
6) Proposed Dam Site (Little Gardenhire)	3		3		
7) Fill Material Area	12				
8) Explosives Storage	2				
9) Mine Support	73				
10) Raw Shale Embank.	12			1*	
11) Rock Stockpiles	4				
12) Topsoil Stockpiles	13		11		10
13) Water Discharge & Application Area	4				2
14) Abandoned Access Road	10		10		
15) Process Facility					74
16) Water Treating Facility					5
17) Cut Bank Mat'l Area					12
18) Pond "C" Pipelines	2		2		
19) Irrigation Pipeline	4		4		
20) Reinjection Pipeline					14
21) Pond "D"					3
22) Injection Station					1
23) Drill Pads & Roads	6		3**	1**	11
TOTALS	188	0	33	2	132

[1] Numerated Areas in column correspond to numerated areas on "C-b Tract Disturbed Areas Map" #AD-0039 Rev. 3, 1982, Figure 6-1 (jacket map).

*Drill pad for monitoring well 32Y-12 (adjacent to raw shale embankment and included in those disturbed acres).

**Drill pad 22X-12 was erroneously reported as being reclaimed in 1981. Corrections have been made.

TABLE 6-2

SPECIES LIST FOR TEMPORARY RECLAMATION+

Species		Lbs./Acre Broadcast
*Agropyron intermedium	intermediate wheatgrass	4
*Agropyron riparium	streambank wheatgrass	4
*Agropyron smithii	western wheatgrass	4
*Lolium multiflorum	annual ryegrass	4
*Lolium perenne	perennial ryegrass	4
*Melilotus spp.	sweetclover	1
	TOTAL	21 lbs./acre

* Seed (P.L.S. - Pure Live Seed)
\+ Temporary reclamation - slopes, laydown areas, fill material borrow areas, etc., which are involved in continuing and/or expected future development activities.

6.4.4 Revegetation

The areas revegetated in 1982 were the two drill pads (32Y-12 and 21X-12) and the temporary laydown area. The areas which were seeded with the temporary seed mix are not considered as being revegetated. Total area revegetated was 2 acres (one additional acre to the 1981 total).

6.4.5 Revegetation Demonstration Plot(s)

In the fall of 1981 a revegetation demonstration plot of raw shale was established on a portion of the raw shale embankment. The plot is approximately 50 square feet and consists of raw shale (approximately 20 feet in depth) covered with topsoil of three depths: 18 inches, 12 inches, and 6 inches. A fairly good stand of perennial grasses and forbs was established in 1982 (first growing season). For results of sampling herbaceous cover, see January 1983 Data Report.

6.5 Overburden and Topsoil Management

6.5.1 Vegetation Plantings/Mixtures

All seeding and mulching in 1982 was conducted in the latter part of October.

Drill pads 32Y-12 and 21X-12 and the laydown area of Pond C were seeded with the permanent seed mixture (Table 6-3). Areas temporarily reclaimed were seeded with the temporary seed mixture (Table 6-2).

Shrub seedlings were transplanted in April, 1982 on the topsoil storage pile west of the Mine Support Area (seeded in 1981) and on the revegetation demonstration plot. About half the seedlings were winter hardened at CB; the remaining ones were transplanted soon after arriving from the nursery. Species planted were those listed in Table 6-3.

No fertilizer was applied during 1982. See Figures 6-2a to 2d for progress on a typical revegetation project from 1979 through 1982, that of the north topsoil stockpile. Analysis of revegetation was limited to an estimate of herbaceous cover on the raw shale revegetation demonstration plot. Herbaceous cover was approximately 8% for all topsoil depths (see January 1983 Data Report).

Shrub seedlings transplanted in the spring of 1981 on topsoil storage piles were evaluated in the spring of 1982 for survivability after one year. The combined survivability for all species was approximately 75%.

6.5.2 Associated Costs

The approximate total cost associated with reclamation and revegetation for 1982 (including temporary seeded areas) was $6,100. The approximate breakdown is as follows: seed and transplants - $3,000; equipment rental - $500; mulch - $600; labor - $2,000.

TABLE 6-3

SPECIES LIST FOR CB RECLAMATION

Species		Lbs/Acre Drilled: North & East and Level Areas	Lbs/Acre Drilled: South & West Areas
Grasses:			
*Agropyron cristatum	- crested wheatgrass	1	1
*A. elongatum	- tall wheatgrass	-	1
*A. spicatum var. inerme	- beardless bluebunch wheatgrass	2	2
*A. smithii (rosana)	- western wheatgrass	1	2
*A. intermedium (amur)	- intermediate wheatgrass	1	2
*Bromus marginatus	- mountain brome	1	-
*Elymus cinereus	- Great basin wildrye	1	-
*E. junceus	- Russian wildrye	1	1/2
*Festuca ovina	- hard sheep fescue	1	-
*Oryzopsis hymenoides	- Indian ricegrass	-	1
Forbs:			
*Hedysarum broeale (Utah)	- Utah sweetvetch	1/2	1/2
*Medicago sativa	- alfalfa	1	1/2
*Penstemon sp.	- penstemon	1/2	1/2
Shrubs:			
+Amelanchier spp	- serviceberry	-	-
*+Artemisia tridentata	- big sagebrush	1/2	-
*Atriplex canescens	- four wing sagebrush	-	2
*A. confertifolia	- shadscale	-	1
*+Cercocarpus montanus	- mountain mahogany	1	1/2
*Cowania mexicana	- stansberry cliffrose	1	1/2
*Eurotia lanata	- winterfat	-	1
*+Purshia tridentata	- bitterbrush	1	1/2
+Symphoricarpos oreophilus	- snowberry		
Trees:			
+Juniperus osteosperma	- Utah juniper		
+J. scopulorum	- Rocky Mountain Juniper		
+Pinus edulis	- pinyon pine		
	TOTAL	13-1/2	15-1/2
		Lbs/Acre	

* Seed (P.L.S. - Pure Live Seed)
\+ Transplants (40 per acre) will be placed selectively in areas of suitability; (North, East and level areas), transplants will total 320 per acre.

NOTE: Forb seed will be innoculated with Northrup King innoculator.

Figure 6-2A Revegetation Progress: North Topsoil Pile as Seen from Southeast Corner. September, 1979

Figure 6-2B August, 1980

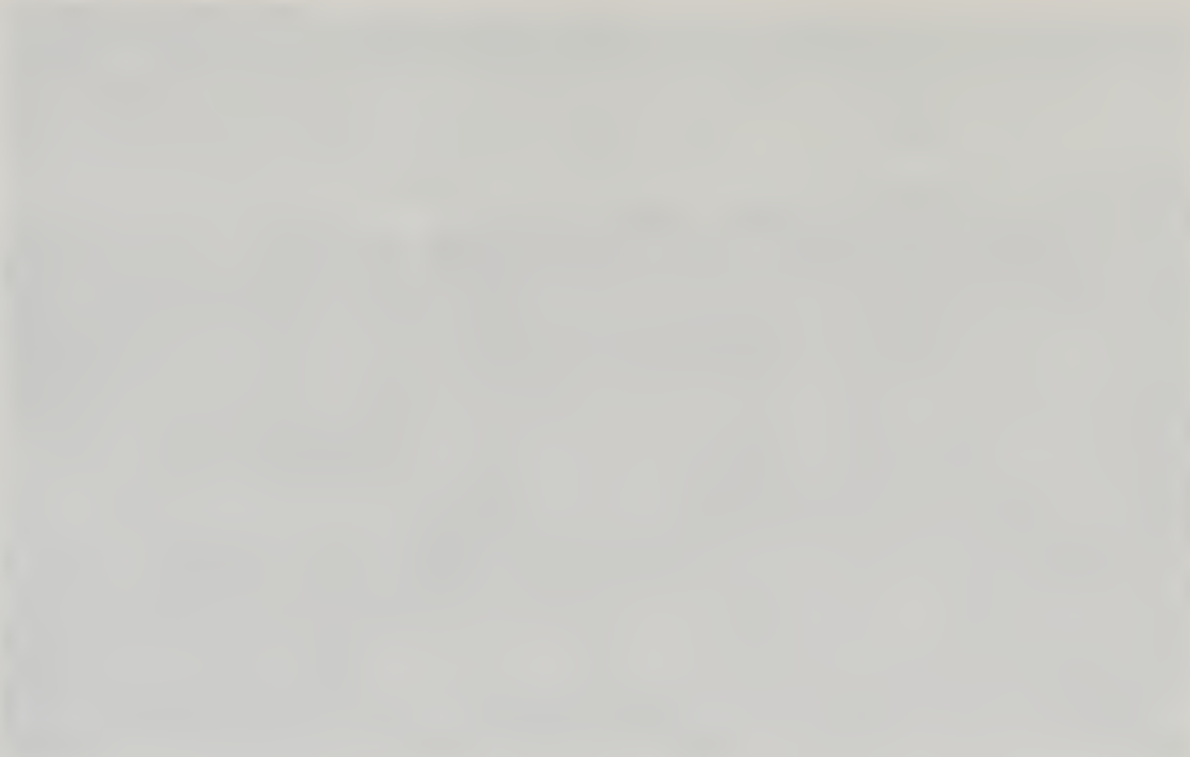
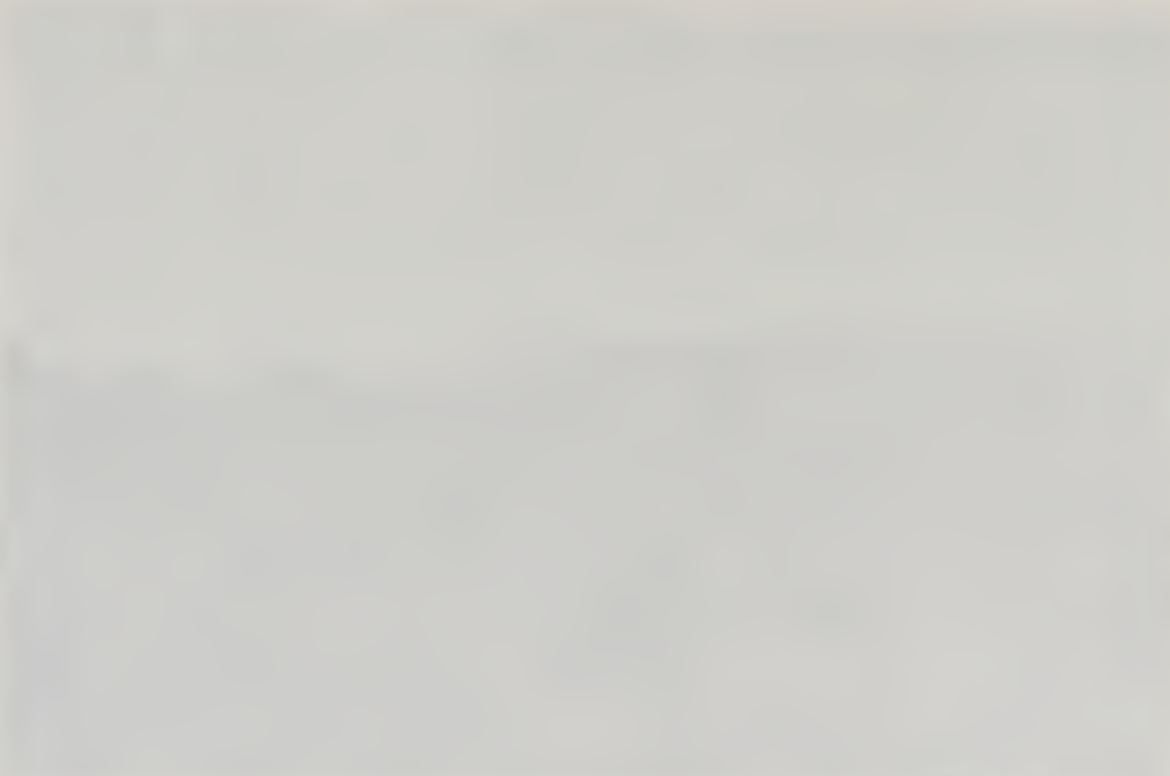


Figure 6-2C August, 1981

Figure 6-2D July, 1982



7.0 ENVIRONMENTAL PROTECTION AND CONTROL

7.1 Air Pollution Control and Visibility

Principal activities in 1982 with the potential to affect air quality included the continued outfitting of the Production and Service Shafts, truck transport along haul roads, operation of the Concrete Batch Plant, continued construction in the Mine Support Area, operation of the temporary power generators, and permitted open burning.

Comparisons of air monitoring measurements with ambient air quality standards are made in Table 9-4; compliance with these standards was achieved in 1982.

Air pollution permit conditions require use of control equipment and operating procedures. Permit status is summarized in Section 7.11 in tabular form showing permit purpose, agency, permit number and approval date.

CB holds a Prevention-of-Significant-Deterioration (PSD) Permit for the Ancillary Phase of MIS operations (defined in 1977 as up to 5,000 barrels/day nominally) from the EPA. An amendment to incorporate aboveground retorting and oil upgrading for a total capacity of 13,500 bbls/calendar day was submitted to the EPA in December 1982.

Baghouses on the Concrete Batch Plant were previously described in the 1979 Annual Report; these represent the only point-source controls required at present. Emissions from temporary power generators require emission source permits; controls are not required, since they are below the horsepower level requiring controls. The Concrete Batch Plant temporarily ceased operations in March 1982. Permanent power was energized in July 1982; temporary power generators were taken out of service at that time.

The CB project obtained a Fugitive Dust Permit (C-11,454) (FD) from the Colorado Air Pollution Control Division in 1977, revised in 1980. Pursuant to this permit, CB paved the major access road to the Tract. This work was completed in August of 1978. PSD and Fugitive Dust Permits require dust control on haul roads by regular applications of water and dust palliatives. The PSD Permit requires quarterly reports to the EPA regarding both total water used and the amount and type of dust palliative applied. Water has been applied to the haul roads on an as-needed basis; dust palliatives have been applied since 1980. The applications of both water and dust palliatives are indicated in Tables 4-3 and 4-4.

The busing system, instituted in 1978 to further reduce road dust by reducing vehicular traffic, continued to be used in 1981 through the spring of 1982 and was then discontinued temporarily because of workforce reductions.

In 1981, a permit was issued by the State of Colorado for a feeder-breaker to crush oil shale rock to minus 8 inch size. Maximum throughput is limited to less then 1,000 tons per hour and annual throughput is limited to

70,000 tons. Water spray bars are utilized as the approved emission control devices. No permit was necessary from the EPA since the annual emission level does not exceed the diminimus level of 25 tons of dust per year based on an emission factor of 0.1 lbs of dust per one ton of rock. The Feeder-Breaker was not used in 1982.

With regard to visibility protection; no specific visibility - related regulations have been promulgated by the EPA. Visibility monitoring has been conducted since 1975, under request of the DMM-OS. No significant degradation in visual range has been noted since the inception of this program. See Section 9.3.5 for further discussion.

7.2 Water Management and Augmentation

The physical description of the water management system is given in Section 4.1.10.

The reinjection test well is designated 11X-18 (computer coded WI18) and is shown near Pond C as facility number 65 on Figure 4-5. A reinjection test was conducted from March 2 thru June 20, 1981. Test protocol was planned as follows:

Injection Rates (gpm)	Test Span (days)
150	30
300	30
450	30

Actual pumping rates are shown on Figure 7-1. Pump failure occurred at the 300 gpm level; a larger pump was installed to achieve 450 gpm. Also shown are well head pressures and pressures at 1,400 foot depth (psi) all on the same scale for the entire period of reinjection to July 1982.

Table 4-3 summarizes water usage by month; annual and cummulative annual values are also shown. Water treatment rates (gpm) are further summarized on Table 7-1.

Regarding compliance with the NPDES permit in 1982, excursions were reported to the State as follows:

Parameter	No. of Excursions
Fluoride	27
Total Dissolved Solids	6
Oil and Grease	2

Although high fluoride values existed in the discharge, consistent with mine waters of the LPC_3 and LPC_4 aquifers, the maximum value in Piceance Creek at the downstream (Hunter Creek) station was 2.0 mg/l and average value for 1982 was 1.3 mg/l. In total dissolved solids (TDS) both individual values

FIGURE 7-1

INJECTION WELL PUMPING PARAMETERS

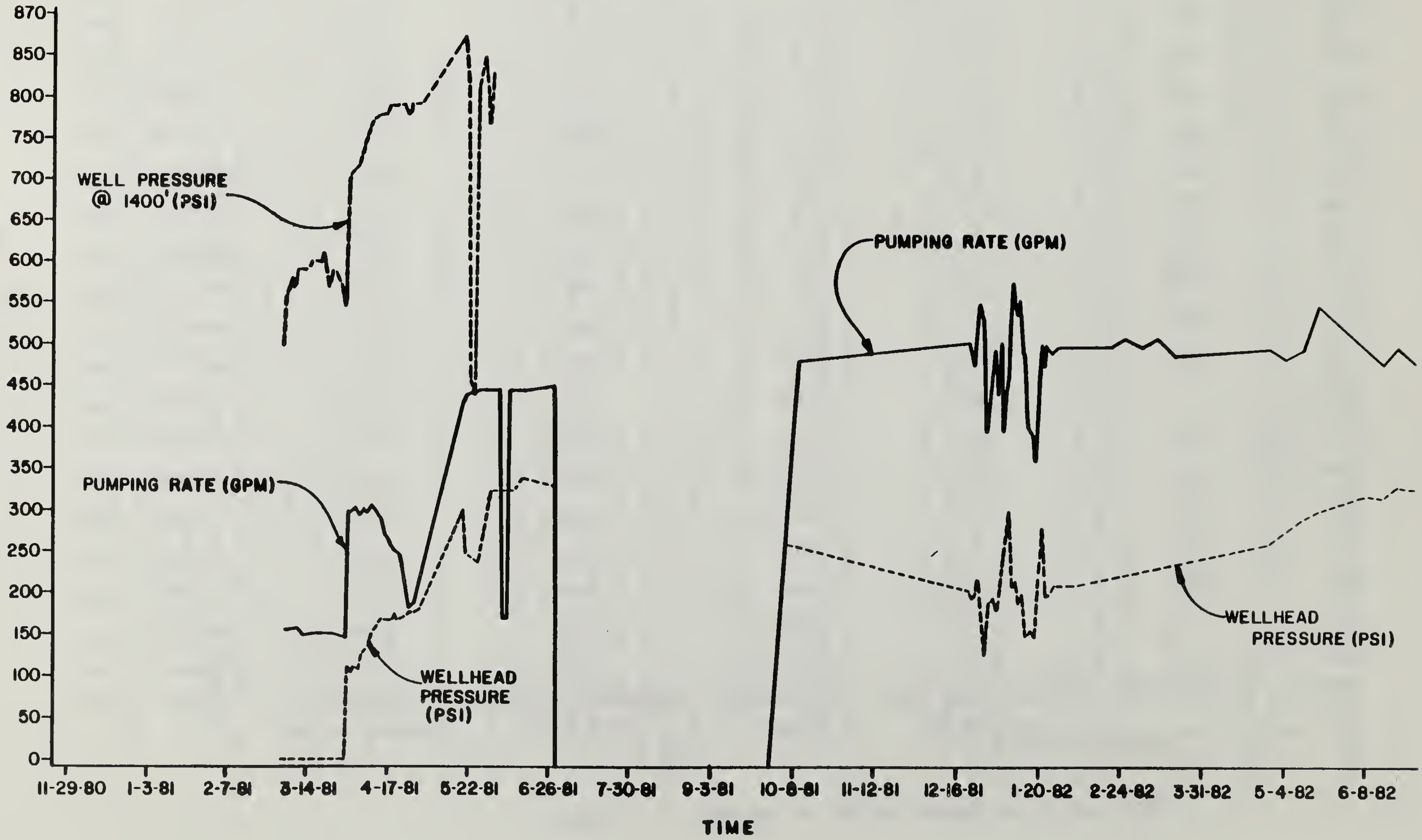


TABLE 7-1 Summary of Water Pumped and Used (gpm)

Year	Month	Water Pumped From Mine [1]	Water Used, Stored, Evaporated [1]	Water Treated [1]: NPDES Discharges	Water Treated [1]: Sprinkler (Land Application)	Water Treated [1]: Reinjection	Water Treated [1]: Total
1981	January	1,645	341	1,304	-	-	1,304
1981	February	1,663	596	1,067	-	-	1,067
1981	March	1,392	498	754	-	140	894
1981	April	1,122	278	583	-	261	844
1981	May	1,636	466	1,109	-	61	1,170
1981	June	1,221	136	745	48	292	1,085
1981	July	1,582	467	739	339	37	1,115
1981	August	1,550	275	942	326	7	1,275
1981	September	617*	180	293	39	105	437
1981	October	627	184	8	-	435	443
1981	November	660	205	16	-	439	455
1981	December	772	298	-	-	474	474
1982	January	664	181	-	-	483	483
1982	February	651	154	5	-	492	497
1982	March	535	90	-	-	445	445
1982	April	476	60	-	-	416	416
1982	May	663	87	-	-	576	576
1982	June	588	83	-	-	505	505
1982	July	560	20	540	-	-	540
1982	August	562	22	540	-	-	540
1982	September	532	7	525	-	-	525
1982	October	472	0	472	-	-	472
1982	November	460	2	458	-	-	458
1982	December	495	0	495	-	-	495

(*Starting September 1, 1981 V/E Shaft was no longer pumped and allowed to fill)

(1) Water Pumped = Water Used + Water Treated

(weekly) and monthly averages are reported; excursions were monthly averages; individual allowable peaks were never exceeded.

Close contact with the State Water Quality Control Division is maintained regarding progress on NPDES permit processing and in-stream classification of Piceance Creek.

Planning of water storage projects has proceeded along two lines:

1) Yellow Jacket Study - this study has been funded by the State of Colorado and is restricted to the Yellow Jacket project and selection of storage sites on the White River or its tributaries above the confluence with Piceance Creek.

2) White River Study - this plan is a joint effort between industry and the Yellow Jacket Conservation District. Work includes evaluation of White River storage alternatives and delivery systems to cover projected Piceance Basin oil shale industry use, other mining and industrial project use, agricultural use and municipal use.

Highlights of the CB Water Augmentation Plan were given in the 1980 report. To the present time no water augmentation by CB for Piceance Basin users has been needed or required by the State Engineer.

7.3 Oil and Hazardous Materials and Associated Spill Contingency

The Spill-Prevention Control and Countermeasure Plan includes a description of the potential for accidental spills or release of oil and other hazardous materials as a result of the Lessee's development of the Tract and associated off-Tract pipelines and terminals. This plan summarizes the potential source of accidental spills, reviews the current regulations and standards that would apply to the Lessee's activities, defines and inventories the hazardous materials within the plant, and presents the Lessee's spill-prevention control and contingency plans for the plant and associated pipelines. The Plan will be updated in 1983 as part of a revision to the DDP.

7.3.1 Summary of Potential and Actual Spills During Construction

During construction activities, spills of diesel fuels and other fuels and lubricants are possible during transportation, loading, and unloading operations, both on-Tract and at construction staging areas and rail spurs. Dust suppressants and smaller amounts of miscellaneous chemicals used during construction activities also pose pollution threats if quantities of these materials reach drainages or flowing streams near the Tract. The trucking, loading, and unloading of fuels and chemicals during construction is a potential source of accidental spills. A program has been initiated to insure that all transformers brought on Tract will not contain PCB's.

There were no reportable spills (see 7.3.3) requiring activities of the spill contingency plan during the year.

7.3.2 Oil and Hazardous Materials Inventory

A list of hazardous substances presently on-Tract is given on Table 7-2. The list identifies those both on-and off-Tract which would be classed as pollutants if allowed to escape; locations are cross-referenced to maps in this report. They are stored consistent with Lease requirements.

7.3.3 Notification Under the Response Plan

In the event of an accidental spill of oil or hazardous material in quantities greater than those specified by the regulations, various governmental entities must be notified. Spills consisting solely of oil are reportable when they reach or have the potential of reaching a water way in quantites which cause a film, sheen or discoloration of the water. Spills involving hazardous materials are defined to be reportable when they occur on the land or reach a water way in quantities exceeding those specified by the regulations.

Notification	Spills Situation
National Response Center (NRC)	"Reportable Spills"
Regional Response Center	When the NRC cannot be contacted
Colorado Department of Health	"Reportable Spills"
Colorado Division of Wildlife	Danger to fish, etc., in surface water supplies
Water Quality Control Division, Colorado Department of Health	Contamination of water supplies
Colorado Highway Department	Move vehicles, control traffic
Oil Shale Office	All spills
BLM, USFS	Certain cases
Local, city, fire, police, health departments	Major spills

7.3.4 Spill Response Team

All spills not involving the product oil pipeline will be responded to by an in-plant spill response team which will be especially organized and trained for this purpose. A Spill Response Coordinator (SRC) has the primary responsibility for deciding the action required and assembling the necessary team elements.

The following is a list of Spill Response Team Members:

Spill Response Coordinator	D. Perdok
Cleanup Coordinator	S. L. Stringer
Government Liaison Coordinator	E. B. Baker
Public Relations Coordinator	R. E. Thomason
Legal Coordinator	D. R. Hale
Environmental Protection Coordinator	E. B. Baker
Procurement and Logistics Coordinator	T. L. Carruthers
Document Coordinator	T. H. Pysto
Accounting Coordinator	L. G. Barth
Training Coordinator	J. A. Fox
Safety and Security Coordinator	E. L. Brake

TABLE 7-2

Oil and Hazardous Materials Inventory

Material Stored	Storage Site No.**	1979 Storage BBL	1980 Storage BBL	1981 Storage BBL	1982 Storage BBL
On-Tract					
Plasticrete	15	50	50	90	1
Diesel Fuel	16	830	2,950	3,000	1,500
Gasoline	16	35	645	1,000	500
Motor Oil and Grease	*	0	0	70	50
Chlorine	15	10	10	0	0
LPG	*	190	850	837	595
Shale Oil	40	0	0	244	0
Sulfuric Acid	43	30	100	100	24

* Stored at numerous locations on construction site.
**See Figures 4-2 and 4-3.

7.4 Waste Disposal

A 9,000 gallon-per-day Sewage Treatment Facility was in operation through September 1982 after which the facility was closed and mothballed. Sewage sludge and gray water treated amounted to approximately 8,000 gallons/-week in January decreasing down to 1,000 gallons/week in September. At present, the sewage is being disposed via porta-johns, and an approved sewage system that has been in operation for seven years is utilized to dispose of that from the C-b offices. Solid waste (trash) accumulated in waste bins was trucked off-site as frequently as necessary to approved landfills in Rifle; total amount for 1982 was approximately 2,000 cubic yards.

7.5 Erosion Control

In the spring of 1982 three additional erosion control basins were constructed on the C-b Tract. Basin #7 is located at the northern edge of disturbance of the cut bank material area. This basin was constructed in conjunction with a basin constructed during 1981 for containment of runoff from the same area; the enlargement of the cut bank material area after the 1981 basin was constructed necessitated the additional basin. Both the 1981 basin and the basin constructed in 1982 are listed as basin #7. Basin #8 is located southeast of the raw shale embankment. The basin includes an 18 inch culvert which diverts the runoff from the raw shale embankment under a road to the basin. The third basin, basin #9, is located at the head of a small drainage at the northeast corner of the land-application disturbed area near Pond C. This brings the total number of erosion control basins on the C-b Tract to nine. For the locations of these basins see "C-b Tract Disturbed Areas Map", Figure 6-1.

7.6 Historic, Scientific, and Aesthetic Values Protection

As part of the Lessee's plan to protect these assets, archaeological and scenic-value studies have been undertaken on the Tract and surrounding area and reported in prior years; no new studies were conducted or needed. In view of the relatively light Tract activities in 1982 no archaeological "findings" were expected, nor have they occurred.

It is to be noted that, other than the tops of the three mine-shaft headframes, no other on-Tract disturbance is visible from Piceance Creek Road.

7.7 Health, Safety and Security

7.7.1 Program and Services

7.7.1.1 General

All levels of the CB management have a complete commitment to employee protection. Various contractors conduct regular safety meetings for their employees with the active participation of the CB management. New employees are required to receive health and safety training prior to being assigned work duties.

On site (1982), CB's Health/Safety/Security staff was phased down to the current level of three security officers by the end of the year. By mid-1982 Grand Junction-based personnel consisted of the Director of Health, Safety and Security.

By the end of the year the need for on-site emergency medical service was reduced. Four EMT's remain on the staff for emergency treatment. A fully equipped ambulance is still available for emergency transport to hospitals in Rifle or Meeker. St. Mary's Airlift helicopter is available for extreme medical emergencies twenty-four hours a day.

An industrial hygiene study on the health effects of workers in MIS oil shale processing was completed during 1982 at Occidental's Logan Wash facility. Results of this CB funded study and preliminary results of a similar study, conducted by Los Alamos Scientific Laboratories and funded by the National Institute of Occupational Safety and Health, have indicated that no serious occupational exposure to contaminants exists.

7.7.1.2 Manhours/Accident Frequency Rate

Following are figures depicting the manhours and accident frequency rate for 1982 at the C-b Tract:

	Manhours	Reportable Accidents	Incident* Rate
CB	93,468	1	2.13
Contractors	229,000	4	3.49
Total	322,468	5	3.10

$$* \text{ IR} = \text{Incident Rate} = \frac{\text{No. of Reportable Accidents X 200,000}}{\text{Hours of Employee Exposure}}$$

7.7.1.3 Inspections and Violations

Cathedral Bluffs had a total of 15 MSHA inspection days during the year 1982; there were no State inspection days. The number of citations received during the year 1982 was 9, 7 of which have been resolved and the remaining 2 are in process.

OSO also performs inspections for Lease and DDP compliance. Copies of inspection reports were furnished to the Project.

7.7.2 Possible Health Hazards

7.7.2.1 Dust

Dust is controlled on unpaved sections of roadways by the application of water and/or dust suppressant. Dust is

controlled during rock drilling operations by the use of water. Although there have been no surveys conducted yet to determine full-shift mine employee exposure to dust, it is not anticipated that problems exist in this area due to the large amount of groundwater released during mining operations. Respirators are provided for employee use when assigned to dusty areas both aboveground and in the mine.

7.7.2.2 Noise Control

Occupational noise control for employee protection is accomplished where feasible by equipment design. When this approach is not feasible, or when engineering design does not reduce noise levels below the maximum allowable limit, all exposed persons are required to wear ear protection.

Ambient noise-level monitoring at the northern Tract boundary during peek construction indicated noise levels in compliance with State regulations for an industrial zone.

7.7.3 Fire Control

The fire control systems utilized at the C-b Tract include the following:

- Dry chemical hand-held and wheeled fire extinguishers for protecting all buildings, including headframes.
- A twin agent (dry chemical/water foam) trailer extinguisher for large fire protection.
- A portable water tank (pickup truck mounted) available for use in extinguishing brush fires that might develop on site.

Fire control training has been provided for both surface and underground situations. A mine-rescue team existed on site in 1982.

7.7.4 Gas

The shafts were classed as gassy on January 2, 1980 by the Mine Safety and Health Administration (MSHA). During 1982, preshift and on-shift examinations for methane at all working places underground continued around the clock in accordance with MSHA regulations. Logs of that activity are kept on site. Samples of the mine atmosphere for gas chromatograph analysis were taken intermittently throughout the year. No hazardous concentrations of methane were detected during 1982.

7.7.5 Explosives Handling and Storage

Explosives when needed for mining and surface construction use are stored in remotely located surface magazines (facility #63, located on

Figure 4-6) which meet the criteria of the appropriate regulatory agencies. Explosives handling and transportation from magazine to the work site are conducted only by experienced, trained workers. Damaged and outdated explosives are burned in a remote location on Tract by the safety personnel under appropriate permit.

7.8 Fish and Wildlife Protection

7.8.1 Objectives of the Fish and Wildlife Protection Plan

The Fish and Wildlife Protection Plan has been developed to provide procedures to avoid or minimize adverse effects on fish and wildlife caused by the development and operation of oil shale facilities on Tract C-b. The habitat management plan uses the baseline environmental data as a frame of reference. It delineates habitat losses that may occur and mitigation efforts needed to either replace in-kind or to improve alternative habitat for selected species of animals.

7.8.2 Stream Classification

Extensive effort was expended in 1982 by CB to secure favorable stream standards and classifications for the "Lower Colorado", including Piceance Basin. Although the classifications were officially to be adopted in 1983, unofficial agreement was reached in late 1982 with the following tentative classifications for the vicinity of the C-b Tract:

Class 2 Warm Water Aquatic Life, Agriculture and Class 2 Recreation to Piceance Creek from the Emily Oldland diversion to the White River;

Unclassified designation of all gulches on the C-b Tract with the exception of Stewart Gulch; and

Class 2 Cold Aquatic Life, Agriculture and Class 2 Recreation to Stewart Gulch from its sources to the confluence with Piceance Creek.

7.8.3 Estimated Access Road Effects

It was hypothesized that the main C-b access road might impede deer movement through the pinyon-juniper rangeland north of the Tract. It was also felt that a major ecosystem impact might result from deer/vehicle collisions. Three deer were killed along this road during the 1981-82 study period. These are the first deer killed along the access road. Thus major impacts have not materialized. Our studies and the radio telemetry study by the Department of Energy show that the deer have not significantly altered their use patterns near the access road.

7.8.4 Mitigative Actions

7.8.4.1 Brush Beating

The 1980 brush beating areas were again sampled for herbaceous productivity, species composition and deer and lagomorph

abundance. The vegetation study still indicated a significant difference between control and beaten areas. Control areas had lower production rates. Use of the area by mule deer was light. A comparison of differences of deer pellet densities between treatment and control was done using a 2-level nested ANOVA. The differences were not significant ($F = 1.09$; $df = 1, 7$; $P = 0.33$). At this date, there is no indication that this mitigation procedure effectively increases deer carrying capacity. However, we may not be measuring the most significant parameters to effectively test the beneficial effects to mule deer. For instance, cattle could inhabit the brush beating area and forego the forage on the side slopes (which they usually consume) for the deer. For lagomorph abundance, the low values for the brush-beaten sagebrush plots suggest real differences between these treatment/ control sites. Control plots in unmodified sagebrush have considerably higher values for the past two years. Differences for both 1980-81 and 1981-82 were significant ($t = 2.6$, $df = 7$, $P = 0.04$; and $t = 2.65$, $df = 7$, $P = 0.03$, respectively). Presently, it seems premature to attempt definitive conclusions regarding the seemingly negative effects of brush beating on cottontail populations.

7.8.4.2 Land Application System

The land application (sprinkler) system was in operation in the summer of 1981, but not in 1982. The main objective of the irrigation system was to provide a method of disposing of excess mining water during the summer months until such time as the water can be used for retort processing or for reinjection.

Deer pellet densities, lagomorph abundance, small mammal abundance and browse utilization remained similar to previous years (Section 9.3.8). Analysis of the wildlife studies in the previously irrigated area did not show any significant differences between the sprinkler area and control areas. These results indicate that continued studies measuring the effects of the sprinkler system on wildlife can be dropped since no differences are being noticed.

7.8.4.3 Deer/Reflector Program

The Cathedral Bluffs Shale Oil Company, in conjunction with the Colorado Division of Wildlife, Oil Shale Office, Rio Blanco Oil Shale Company, Department of Energy and other agencies, is testing a new type of deer/vehicle reflector. The reflectors were installed along four miles of the Piceance Creek Highway (see 1981 Annual Report). Five deer were killed in the study area. This kill is small when compared to the total Piceance Creek Road kill of 54 deer. The study was not started until February 8, 1982 which may account for the low road kill. Twenty-four deer were already killed along the highway before the study began. Three deer were killed while the reflectors were covered (i.e. inoperable) while only two deer were killed when the reflectors were in operation. This sample size is too small from which to draw any conclusions. The reflector study will continue through at least May of 1983.

7.8.5 Springs Development - Cottonwood Gulch

In the fall of 1981, an existing spring in Cottonwood Gulch was developed. The spring is producing 2 to 3 gallons per minute. The on-site stock tank was used quite heavily by livestock in the spring and the fall of 1982.

7.8.6 Future Possible Mitigation Projects

Several mitigation projects have been proposed including: approved burning and plot fertilization, selected species planting in chained areas, fencing for improved cattle distribution, additional stock tanks and water wells, and proposed dams for water storage with potential for waterfowl wetlands and fishery habitat. The implementation of mitigation projects will depend on construction activities, success of past mitigation projects and development of new mitigation techniques.

7.9 Off-Tract Corridors

No additional corridors were under development this year.

7.10 Abandonment

The Abandonment Plan is contained in Supplemental Material to Detailed Development Plan Modifications submitted July, 1977. The plan is still valid. It will be updated with detailed specifications for DMM-OS approval prior to actual abandonment or to coincide with any future DDP modifications.

7.11 Permit Status

A CB Permit Status Report of permits obtained to date is presented on Table 7-3.

7.12 Environmental Assessments

Tenneco and Occidental maintain a policy which requires annual assessments for environmental compliance. The CB project was reviewed in January, 1982 by the Tenneco audit group, and by Occidental's corporate environmental review staff. No significant problems were noted, and suggested improvements to ongoing programs were initiated.

TABLE 7-3 Status of Current Permits/Notices

Permit Title	Purpose	Permitting Agency	Permit No.	Date Submitted	Date Approved	Date of Expiration	Remarks
Air							
1) PSD	For Ancillary Development of 5000/B/D MIS facility	EPA	N/A	10/17/77	12/15/77	N/A	Construction commenced 1978. Schedule revised in 12/82 application for amendment to permit adding AGR and OUG.
2) Fugitive Dust Permit	Surface disturbance	CAQCD	C-11,454 (FD)	6/27/77	12/28/77 Rev 8/05/80	10/31/86	
3) Emission Permit	Concrete Batch Plant	CAQCD	C-11,931	5/18/78	6/23/78	Indefinite	
4) Open Burning Permit	Dynamite disposal	CAQCD	1860-OB-0004	2/83	3/83	4/84	
5) Emission Permits (4)	Electric (natural gas-fueled generators)	CAQCD	C-12,255 (1-4)	12/04/78	3/15/79	Indefinite	
6) APEN	Feeder Breaker	CAQCD	C-13,244 (FD)	3/06/81	4/20/81 (State) 5/18/81 (EPA)		

TABLE 7-3 Status of Current Permits/Notices (Contd)

Permit Title	Purpose	Permitting Agency	Permit No.	Date Submitted	Date Approved	Date of Expiration	Remarks
Water							
1) NPDES	Water discharge to Piceance Creek	CWQCD	CO-0033961	8/19/77 Rev 6/30/80 New appl. 6/30/82	3/27/79 12/8/80	12/31/82	Pending final action by CWQCD.
2) SPCC	To comply with the Clean Water Act	CWQCD, OSO, EPA	N/A	11/79	Not required	Update required every 3 years	1982 revision completed pending Registered Engineer's final review.
3) Water Augmentation Plan	Depletion Mitigation for holders of senior rights	Water Court	W-3492	8/31/77	5/21/79	Project Life	Diligence filing was approved in 1982.
4) Well Permits (34)	Covers permits for 29 wells and 5 shafts filed under Augmentation Plan for any beneficial use.	State Engineer	W-3493	8/31/77	5/21/79	N/A	
5) Sewage Plant Site Approval	Sewage plant	CWQCD	Site 2852	8/06/80	8/28/80	N/A	
6) Sewage Plant	Sewage disposal	CWQCD	Site 2852	9/22/80	11/03/80	Indefinite	9000 GPD Plant.
7) Dam Permit	Dam construction in East No-Name Gulch - 1000 ac ft storage.	Colo.Dept. of Natural Resources, State Eng.	C-1591		8/27/80	N/A	

TABLE 7-3 Status of Current Permits/Notices (Contd)

Permit Title	Purpose	Permitting Agency	Permit No.	Date Submitted	Date Approved	Date of Expiration	Remarks
Land							
1) Lease	Tract C-b development	USGS/OSO	C-20341		4/74	4/96	Lease paid to 3/31/83
2) DDP & MDDP	Lease compliance	USGS/OSO	N/A	2/77	8/77	Life of Lease	1982-83 Interim Plan approved 7/22/82.
3) Monument Peak Right-of-Way	Microwave communi- cations	BLM	C-25677	7/31/77	10/20/77	Indefinite	
4) Road Right-of-Way	Construct access road	BLM	C-15827 RW	9/13/77	1/24/78	Indefinite	
5) Notice of Prospecting	Site preparation and shaft sinking activities	CMLRB		3/77	Not required		
6) ROW/SLUPS	Monitoring wells and access roads		C-22010 22011 22804 28390			See remarks	New ROW applied for 9/80. BLM pro- cessing. Expect issuance in 1983.
7) Mined Land Reclamation Plan	Surface disturbance reclamation	CMLRB	77-530	11/07/77	3/23/78	Life of Project	Annual reclamation report due 3/83.
8) Special Use Permit	Permanent zoning	Rio Blanco Co		10/10/78		Indefinite	Follows approved DPP.
9) MLRB Plan	Sewer Plant site	MLRB			8/28/80	Indefinite	
10) Utility Corridors	Power lines Pipelines	Rio Blanco Co	N/A			N/A	138 KVA White River Electirc line (constructed) will serve project. La Sal pipeline EIS approved by BLM. ROW application pending. Serves project needs.

TABLE 7-3 Status of Current Permits/Notices (Contd)

Permit Title	Purpose	Permitting Agency	Permit No.	Date Submitted	Date Approved	Date of Expiration	Remarks
Resource Conservation and Recovery Act (RCRA)							
1) Notice of hazardous waste activity	Generate & ship hazardous waste	EPA	EPA ID# COD 000 716530	8/18/80	N/A	N/A	Notice submitted EPA covering the event CB should encounter any hazardous waste.
Others							
1) FCC Licenses (4)	Microwave communi-cations	FCC	Lic. No. 007015-000	9/5/78	12/5/78	12/5/83	No action needed until 90 days prior to 12/5/83. Permit for hand-held radios expires 12/82. Application made 11/82.
2) Notice to FAA of Pro-posed Construction	Structures over 200 ft.	FAA	N/A	8/18/78	None Required	N/A	Proper notification made. No further action needed.
3) Heliport Location	Heliport construction	DOI/OSO, FAA	N/A	4/26/80	4/26/80	Indefinite	
4) Radioactive Materials License	Operate neutron moisture probe for soil moisture monitoring spinkler plots.	Colo.Dept. Health	Colo 437-0	5/01/80	6/31/80	6/31/85	Source to be tested every 6 months. Annual assessment by management. Source tested 9/82.
5) TSCA-Inventory of Chemical Substances	Registration of shale oil	EPA	N/A	4/26/78	N/A	N/A	Shale oil (from any and all processes) is on the inventory of existing chemical substances. A premanufacture notice will not be required.

8.0 SOCIOECONOMIC ACTIVITIES

Socioeconomic activities include analysis of the workforce and the associated population buildup, Mitigation Task Force support, community donations and public relations. Each is discussed in turn.

8.1 Work Force

The work force at the C-b site decreased during 1982 from a level of 600 employees in December, 1981 to a year-end level of 30 employees. Total persons employed directly by Cathedral Bluffs, including Grand Junction Staff, decreased slightly from 110 in January to 85 in December.

8.2 Population

Population growth in the Rifle and Meeker areas declined during 1982 due to the shutdown of the Colony project, the Northern Coal mine and reduction in work effort at C-a and C-b. Work on the Union Project remained stable.

8.3 Transportation

The C-b employee bus system was discontinued in 1982 due to the reduction in work effort.

8.4 Housing

CB continued to operate the 103 unit King's Crown mobile home park in Rifle for employee housing. Leased apartment units in Meeker and Rifle have been, or will be, transferred back to their respective owners. The total net cost of operating employee housing in 1982 was $129,363.

Preliminary site planning continued for the Condon Parcel, a 113 acre parcel of land in Rifle owned by the CB project. The land is proposed to be developed into approximately 550 total housing units, arranged in a mix between apartments, townhouses, mobile homes and other housing types, as necessary.

8.5 Mitigation Task Force Support

In 1981, an agreement was executed calling for the development of a socioeconomic impact mitigation program jointly by CB and Rio Blanco County. This effort was placed on hold pending redefinition and redirection of the project.

In forecasting future employment and population growth trends, CB has utilized a model in 1982 (i.e., Planning and Assessment System Model (PAS)) developed through the efforts of an organization of local, state, federal, and industry interests collectively referred to as the Cumulative Impacts Task Force (CITF). The CITF was established in an effort to devise a means to analyze the cumulative effects of energy development and basic economic activities within a six county region of western Colorado. The PAS model and

related assessment techniques developed in the course of CITF work during 1981-82 have been utilized in the socioeconomic evaluation by CB as contained in the Synthetic Fuels Corporation proposals. Complete details of the various model inputs are available for inspection at CB's Grand Junction offices.

8.6 Community Donations

Table 8-1 lists the budgeted contributions made by CB to various community projects in 1982.

8.7 Public Relations

8.7.1 Lectures, Presentations, Expositions

A number of lectures and/or presentations were made off-Tract by various members of the Cathedral Bluffs staff in 1982.

8.7.2 Other Activities

An employee summer picnic was held at Cameo State Park in August.

Tenneco/Occidental co-sponsored an oil shale exhibit at the 1982 World's Fair (Figures 8-1 and 8-2). This pavillion recreated the in situ process to extract oil from below-ground shale deposits. It was one of the 30 exhibits by major corporations at the fair, which ran from May 1 through October 31 in Knoxville, Tennessee. It is estimated that approximately 800,000 people toured the Tenneco/Occidental pavillion. The exhibit covered 11,000 square feet, with the exterior simulating the Colorado project site and the interior duplicating the shale oil mine there. Exhibits and murals were used in the pavillion entrance to describe the oil shale mining process. A "drift" simulated a passageway in the shale mine through special lighting and sound effects to connect the exhibition hall to a 99-person capacity theater, where a nine minute film explained the shale oil project.

TABLE 8-1a

Cathedral Bluffs - Contribution Status as of December 31, 1982

	Actual at 12/31/82
City of Rifle	$ 1,000.00
Rifle Hospital	2,000.00
Garfield Youth	1,500.00
Community Services - Rifle	500.00
Flight for Life	6,000.00
Community Services - Meeker	2,000.00
St. Mary's Hospital	5,000.00
Miscellaneous (1)	6,150.00
TOTAL	$24,150.00

(1) See Table 8-1b

TABLE 8-1b

Miscellaneous Contribution Listing

	Y-T-D
Mountain States Legal Foundation	$ 750.00
Mesa College Foundation	200.00
Parents Who Care	200.00
Miss Western Colorado Scholarship Program	25.00
Rifle Creek Women's Golf Tournament	100.00
Colorado State Mining Championship	300.00
Grand Junction Blue Knights	175.00
Community Concert Association	150.00
Grand Junction Symphony Orchestra	500.00
Mesa County United Way	1,500.00
Meeker Babe Ruth Association	2,000.00
Mesa College	250.00
TOTAL	$6,150.00

Figure 8-1
The Tenneco/Occidental Oil Shale Exhibit
at the 1982 World's Fair

Figure 8-2
Another View

9.0 ENVIRONMENTAL MONITORING

9.1 Scope

The Environmental Baseline Period for Oil Shale Tract C-b covered the period from November 1, 1974, to October 31, 1976. Results have been reported in nine Quarterly Data Reports, eight Quarterly Summary Reports, C-b Annual Summary and Trends Report (1976), and a 5-volume Environmental Baseline Program Final Report (1977), all submitted to the Oil Shale Supervisor, now designated as the Deputy Minerals Manager - Oil Shale (DMM-OS).

From November 1, 1976 through August 31, 1977, the C-b Tract was under a period of suspension of the Federal Oil Shale Lease. The monitoring conducted during this period was executed under a program known as the Interim Monitoring Phase. Environmental data for this time period were submitted to the Oil Shale Office (OSO) on October 14, 1977 (Interim Monitoring Report #1). The Interim Monitoring Period was later extended by the OSO to cover the period from September 1, 1977 through March 31, 1978. Data for this time period were submitted to the OSO on May 15, 1978 (Interim Monitoring Report #2). The Development Monitoring Program was initiated in April 1978. The Development Monitoring Program for Oil Shale Tract C-b was submitted to the OSO in a document dated February 23, 1979 and approved by the OSO on April 13, 1979 subject to thirteen Conditions of Approval contained in the approval letter. Development Monitoring again reverted to Interim Monitoring status in March 1982 as approved by the DMM-OS and has continued at that level to date. Actually an Interim Development Program and Schedule were approved on July 22, 1982 as DDP amendments. Semiannual environmental data reports are submitted every January 15 and July 15.

The Interim Monitoring and Development Monitoring Programs have been reduced and changed from the Environmental Baseline Monitoring Program in many areas. Therefore, emphasis is now placed on key indicators of environmental quality and/or change.

9.2 Purpose

The purpose of the Annual Report is to fulfill the requirement of the Lease to provide the Deputy Minerals Manager's Office with an annual summary of environmental monitoring. The Development Monitoring Plan states the following objectives with respect to environmental monitoring:

> The purposes or objectives of environmental monitoring as defined in Section 1 (C) of the Stipulations are to provide: (1) a record of changes from conditons existing prior to development operations, as established by the collection of baseline data, (2) a continuing check on compliance with the provisions of the Lease and Stipulations, and all applicable federal, state and local environmental protection and pollution control requirements, (3) timely notice of detrimental effects and conditions requiring correction, and (4) factual basis for revision or amendment of the Stipulations.

The approach taken utilizes the simple, multicomponent, conceptual model shown on Figure 9-1. The "outputs" or actions constitute the monitoring plan and its implementation (findings) as a result of monitoring (Box 4). "Inputs" consist of the environmental data base, the Lease Environmental Stipulations, the details of Tract operation, and applicable local, state, and federal regulations (Box 1). The mid-component or "decision matrix" (Box 2) consists of the three major criteria to which candidate variables for monitoring are subjected (relatability, observability, and measurability). The selected variables in the Program which are "screened" by these criteria become known as indicator variables. A significant feature of this conceptual model is its feedback capability. That is, variable levels (or magnitudes) are assessed against "expected" levels (Box 5). In the event that high levels are obtained, a "systems dependent" mode of either more intensive monitoring, use of additional stations, or added variables (or all three) is triggered as illustrated in Box 6. Feedback from the program results to date to obtain improved inputs ensures continual review and refinement of the monitoring programs as additional information is collected and analyzed. This is a provision not only for the evolution of the monitoring program in terms of methods used in collecting and analyzing data and for refining sampling frequencies and locations, but also a provision for factoring in the phases of development and their subsequent effects on the system.

9.3 Summary of Environmental Monitoring

Environmental monitoring and analyses are continuing on Tract C-b. Development activities commenced within the past five years have resulted in activity on the Tract in the form of off-road vehicular use, facility construction, shaft sinking and outfitting associated headframes, and traffic into and out of the area. All activities have been conducted within strict adherence to environmental, permit, and lease regulations. Environmental impacts, where they exist, have been confined to the immediate Tract development areas and within limits defined in the Detailed Development Plan.

9.3.1 Indicator Variables

The environmental monitoring program has been brought into sharper focus with the identification of Class 1 indicator variables. These are key environmental variables collected at representative stations in at least monthly sampling frequency. Time series plots, generated by the computer from the data base and all to a common time scale, were discontinued in 1982, but will be reinstated when Development Monitoring resumes. Existing plots are available both in the Grand Junction office and at the OSO.

9.3.2 Tract Imagery

Tract imagery, in forms of color infrared panoramic photographs of vegetation around springs and seeps and use of Landsat for assessment of general vegetative condition, was discontinued in 1982 in view of decreased Tract activity, with OSO approval.

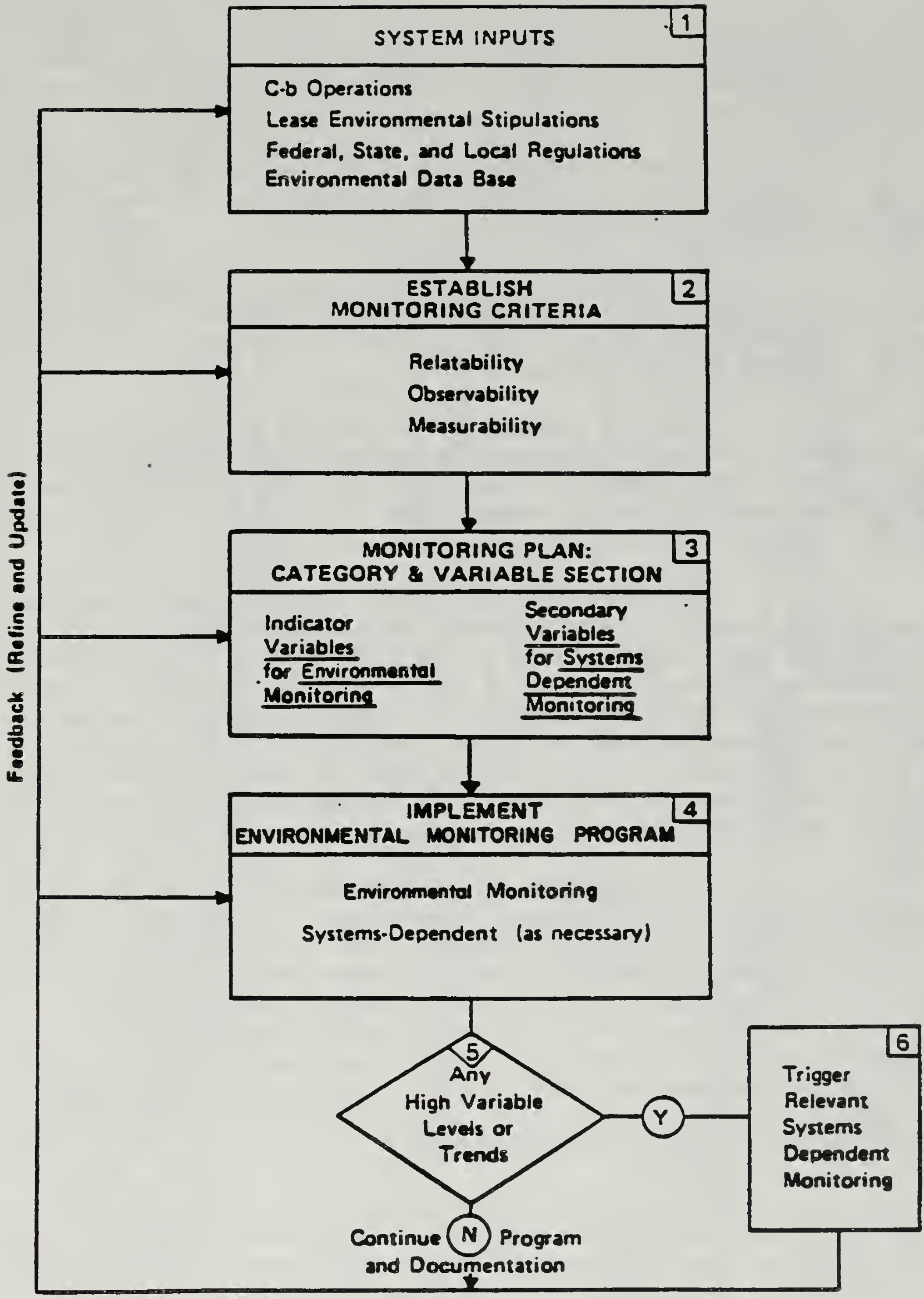


Figure 9-1

Conceptual Approach to Environmental Monitoring

9.3.3 Hydrology and Water Quality

A development monitoring program has been implemented to provide hydrologic and water quality data for the purpose of impact evaluation. Streams, springs, seeps, alluvial and bedrock aquifers, shafts and impoundments are presently monitored. The monitoring station locations are shown in Figures 9-2, 9-3, 9-4, and 9-5.

Prior to any discussion of monitoring results it is useful to review drainage basins of the oil shale region and the stratigraphy of the Tract which governs groundwater flow.

From Figure 9-6 it can be seen that both the Piceance and Yellow Creek Basins drain northerly into the White River. The other drainage basins of the oil shale region, those of Roan and Parachute Creeks, drain southerly into the Colorado River.

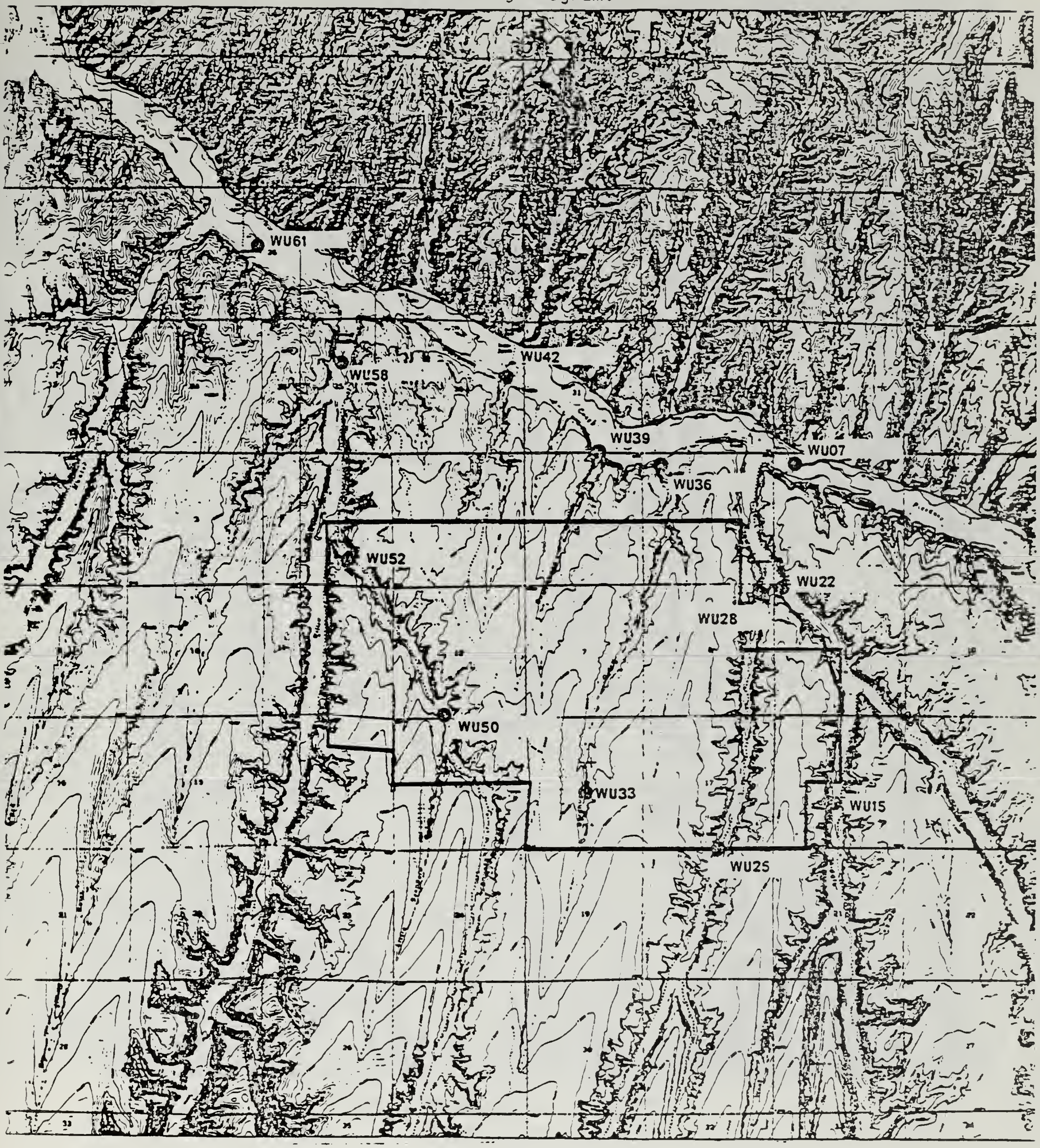
About 80 percent of the annual streamflow in Piceance and Yellow Creeks is said to be supplied by interflow and/or groundwater discharge. Streamflow depletions resulting from irrigation are estimated to be about 25 percent of the natural flow of Piceance and Yellow Creeks, respectively (Weeks and others, 1974).

The simplified two-layer aquifer concept that guided the measurements of flows and levels during the early monitoring program has evolved through study and analysis to the more complex system shown in Figure 9-7. The revised concept identifies six general stratigraphic zones: Upper Uinta, Lower Uinta, Upper Parachute Creek 1 (UPC_1), Upper Parachute Creek 2 (UPC_2), Lower Parachute Creek 3 (LPC_3), and Lower Parachute Creek 4 (LPC_4). The UPC_2 and LPC_3 intervals include the zone to be mined and dewatered. Also shown on the figure is a possible depth of both a room and pillar mine and a modified-in-situ retort, although neither exist at present.

Two additional items potentially affect the hydrologic monitoring program and its results: intentional cessation of dewatering of the V/E shaft and water management practices. The V/E shaft was allowed to fill (with full approval of the DMM-OS) in September 1981, as a temporary cost-savings device (i.e. reduction in cost of pumping for dewatering). Water level in this shaft has reached the equilibrium level shown on Figure 9-8. Water management practices to dispose of excess mine waters from the Production and Service shafts utilized two modes in 1982: direct discharge and/or reinjection into groundwater zones of like water quality. Table 7-1 summarizes water treatment amounts by month via these modes.

With regard to monitoring of stream flow, nine of the 18 stations are located on ephemeral streams. The other nine are considered major stations on perennial streams and record stream flow continuously. The monitoring network is conceptually the same as that used during the baseline period. Baseline studies indicate that the mean flow for the reach of Piceance Creek adjacent to the Tract is approximately 12 CFS. Records since then indicate no significant change in mean annual flow; for example, in 1982 mean

Stations WU15, WU25, WU28, WU33, WU45, and WU50 were discontinued during the Interim Monitoring Program.



U.S.G.S STREAM GAUGE DEVELOPMENT MONITORING NETWORK

Figure 9-2

SPRINGS AND SEEPS AROUND
Cb TRACT

Figure 9-3a

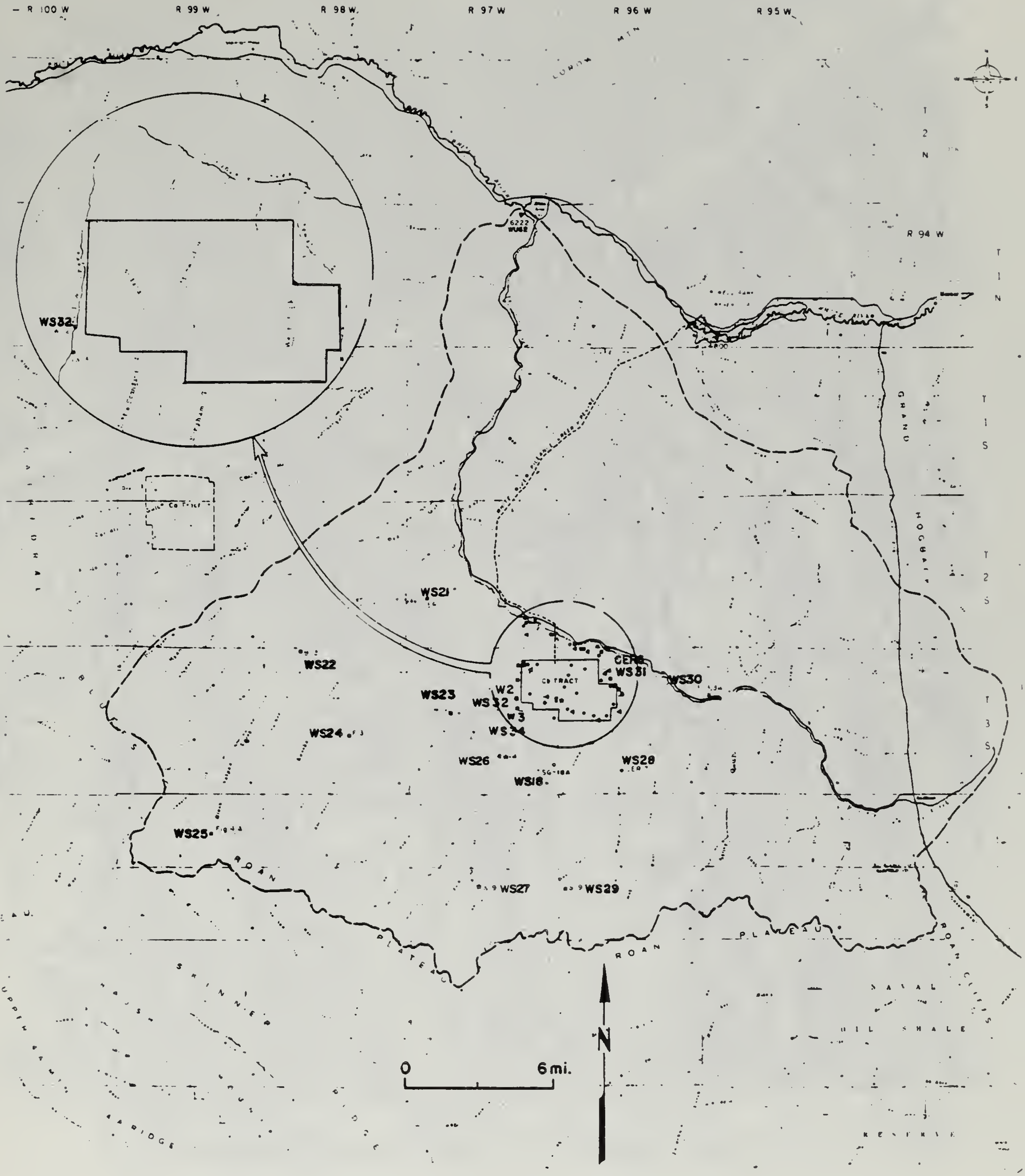


Figure 9-3b

Springs and Seeps Monitoring Network
Off-Tract

ALLUVIAL AQUIFER MONITORING NETWORK

Figure 9-4

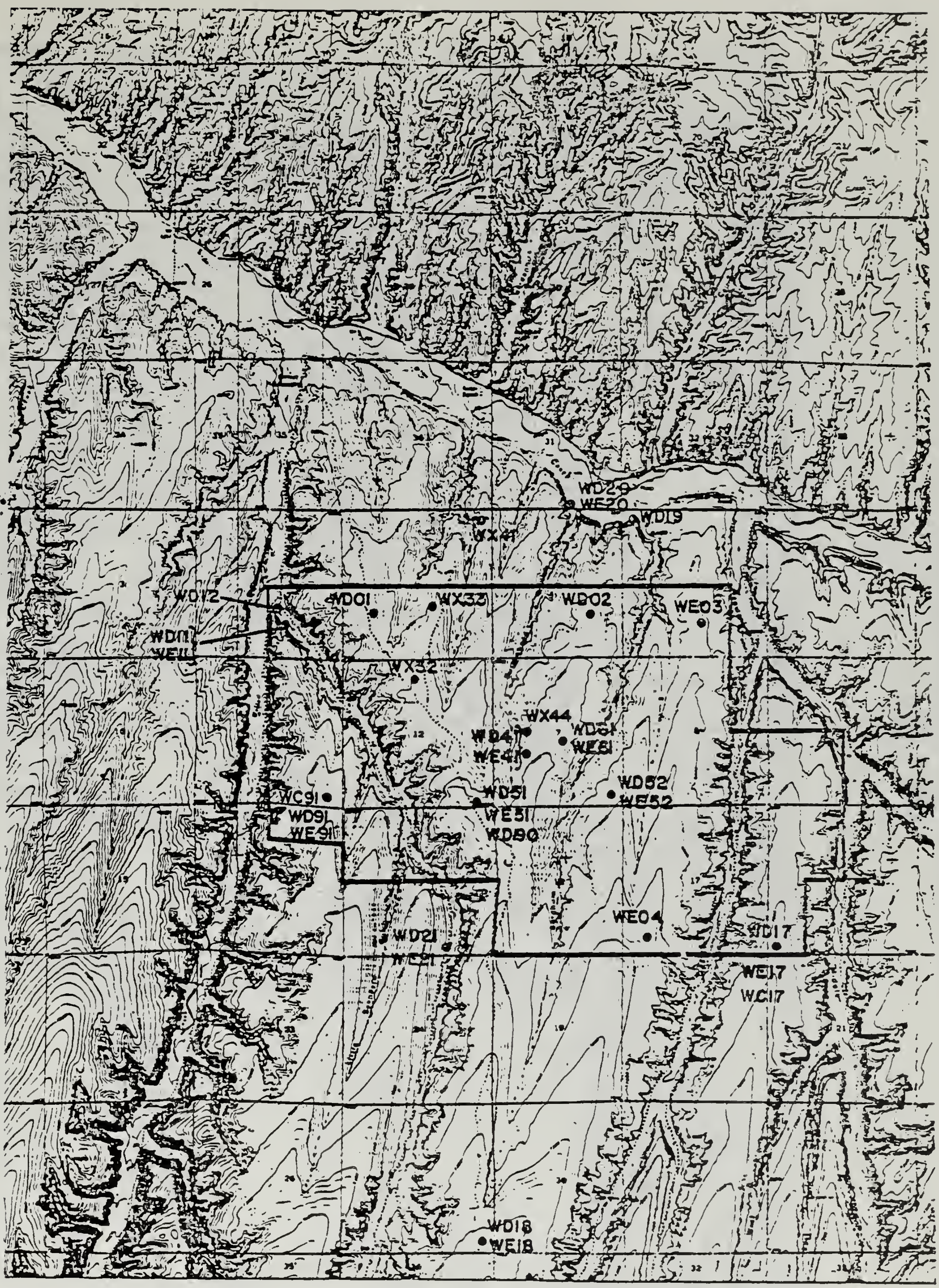


Figure 9-5a
DEEP WELL MONITORING NETWORK NEAR C-b TRACT
FOR UPC_1, UPC_2 ZONES

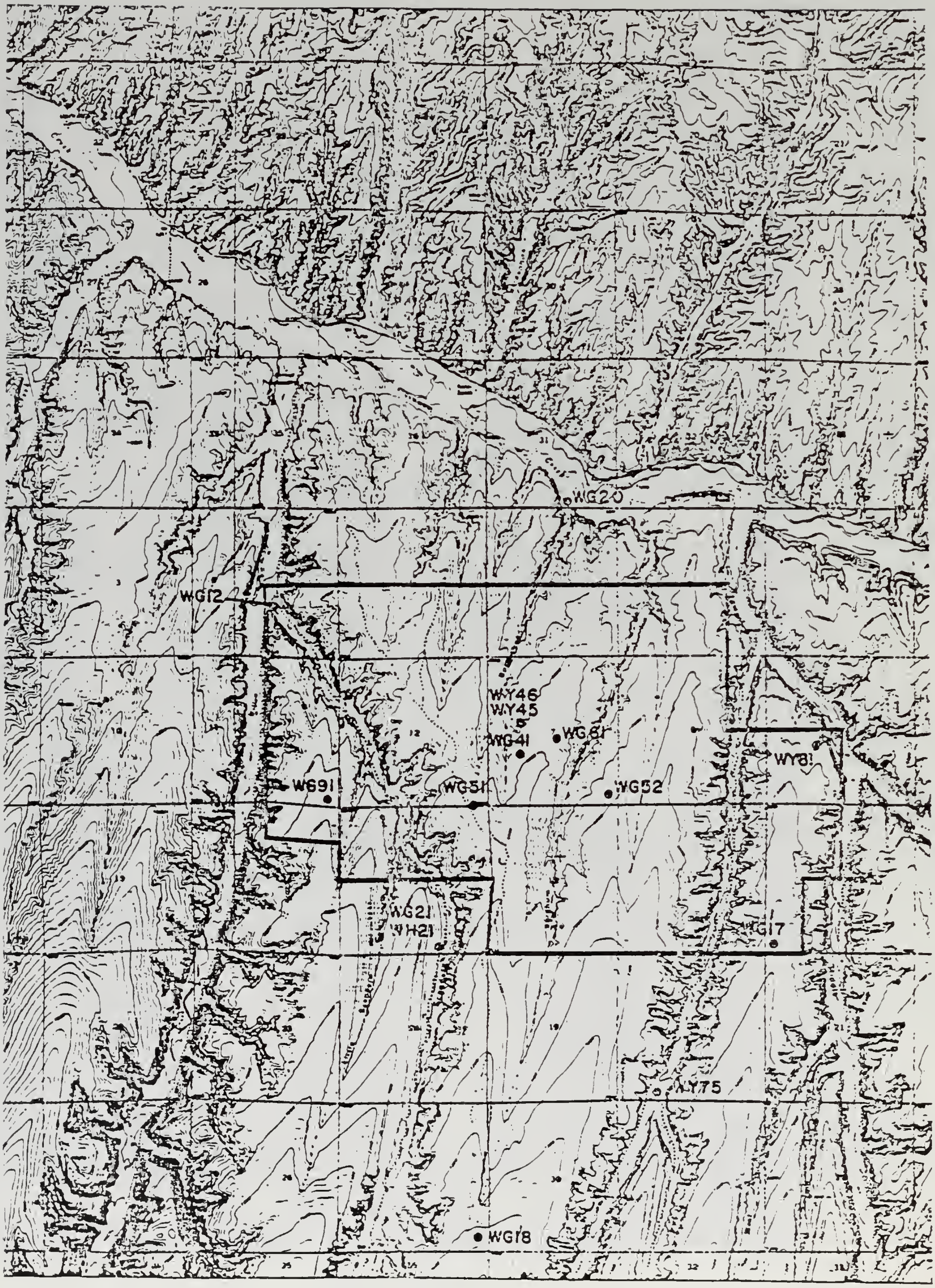


Figure 9-5b
DEEP WELL MONITORING NETWORK NEAR C-b TRACT
FOR LPC_3, LPC_4 ZONES

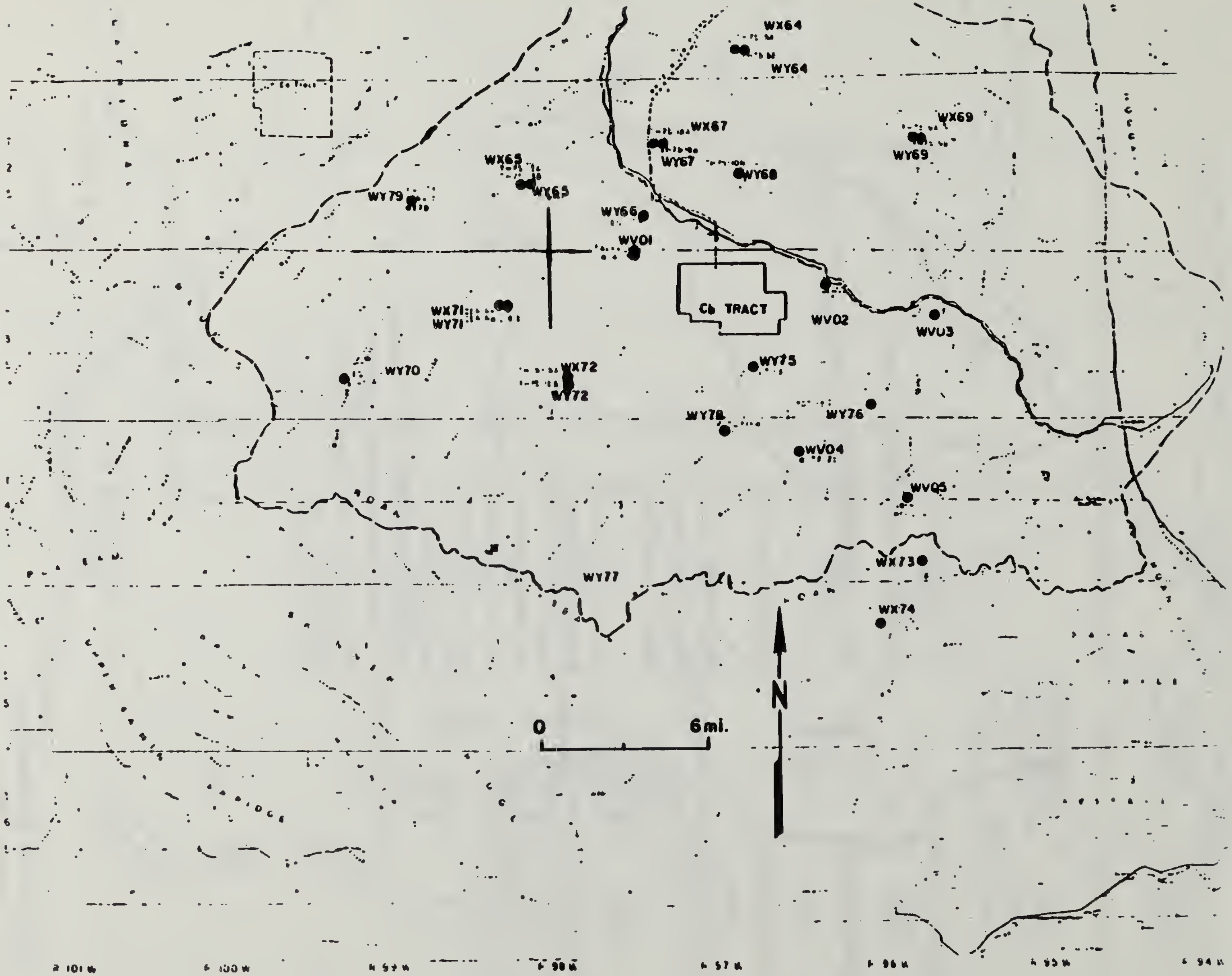


Figure 9-5c
Deep Well Monitoring Network Off-Tract

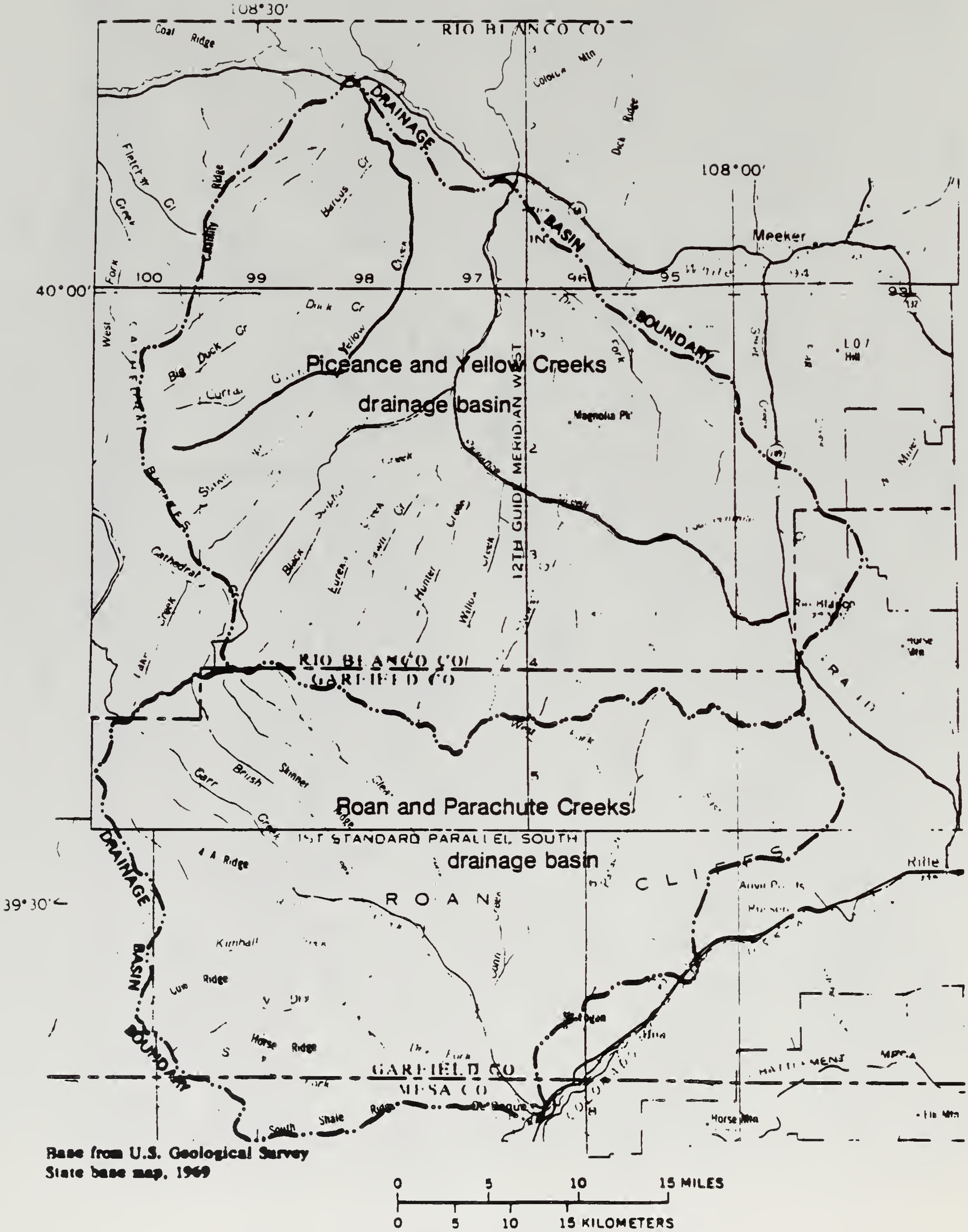
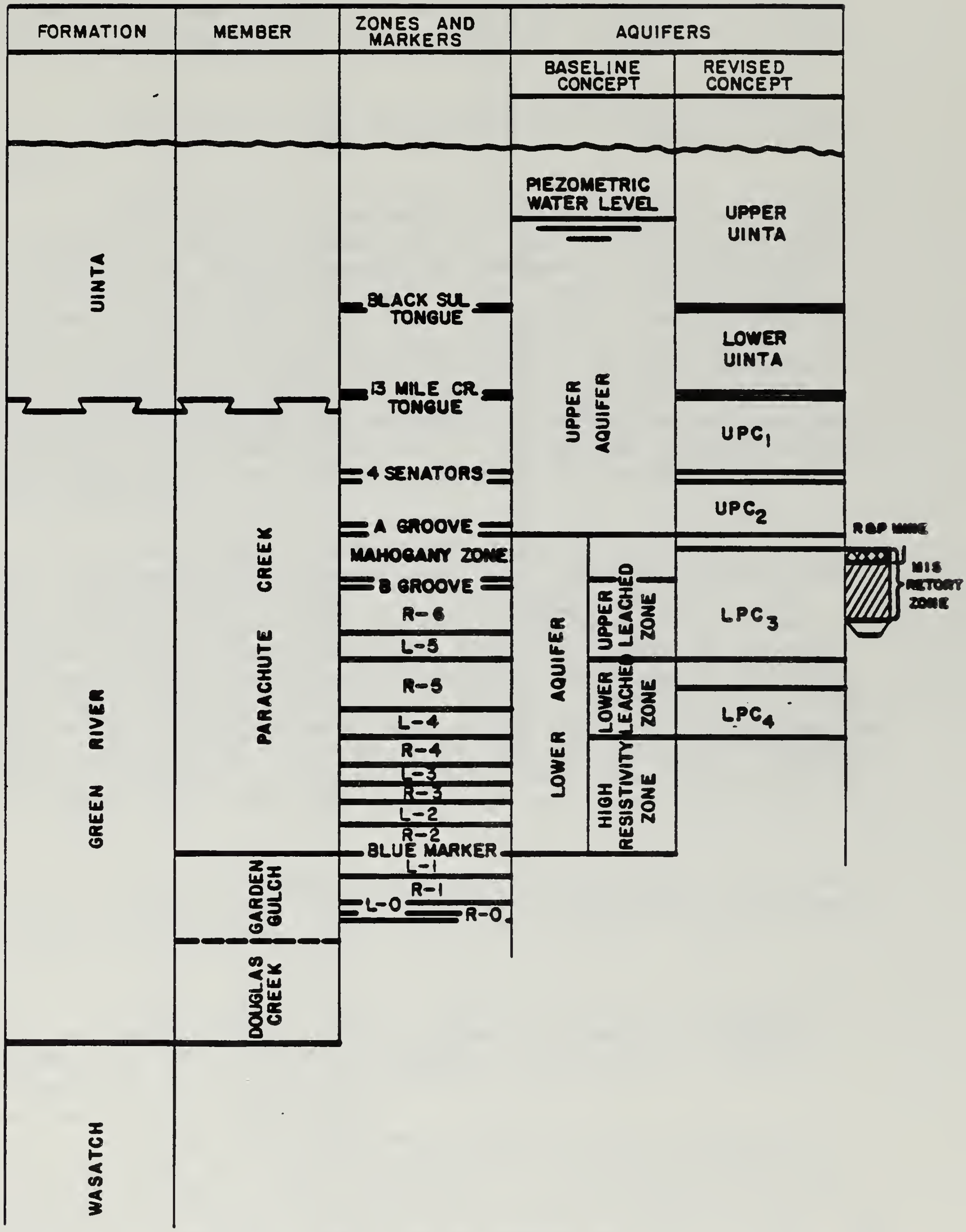


Figure 9-6 Major drainage basins of the oil-shale area of the Piceance structural basin, northwestern Colorado.



STRATIGRAPHIC COLUMN AND AQUIFER CONCEPT

FIGURE 9-7

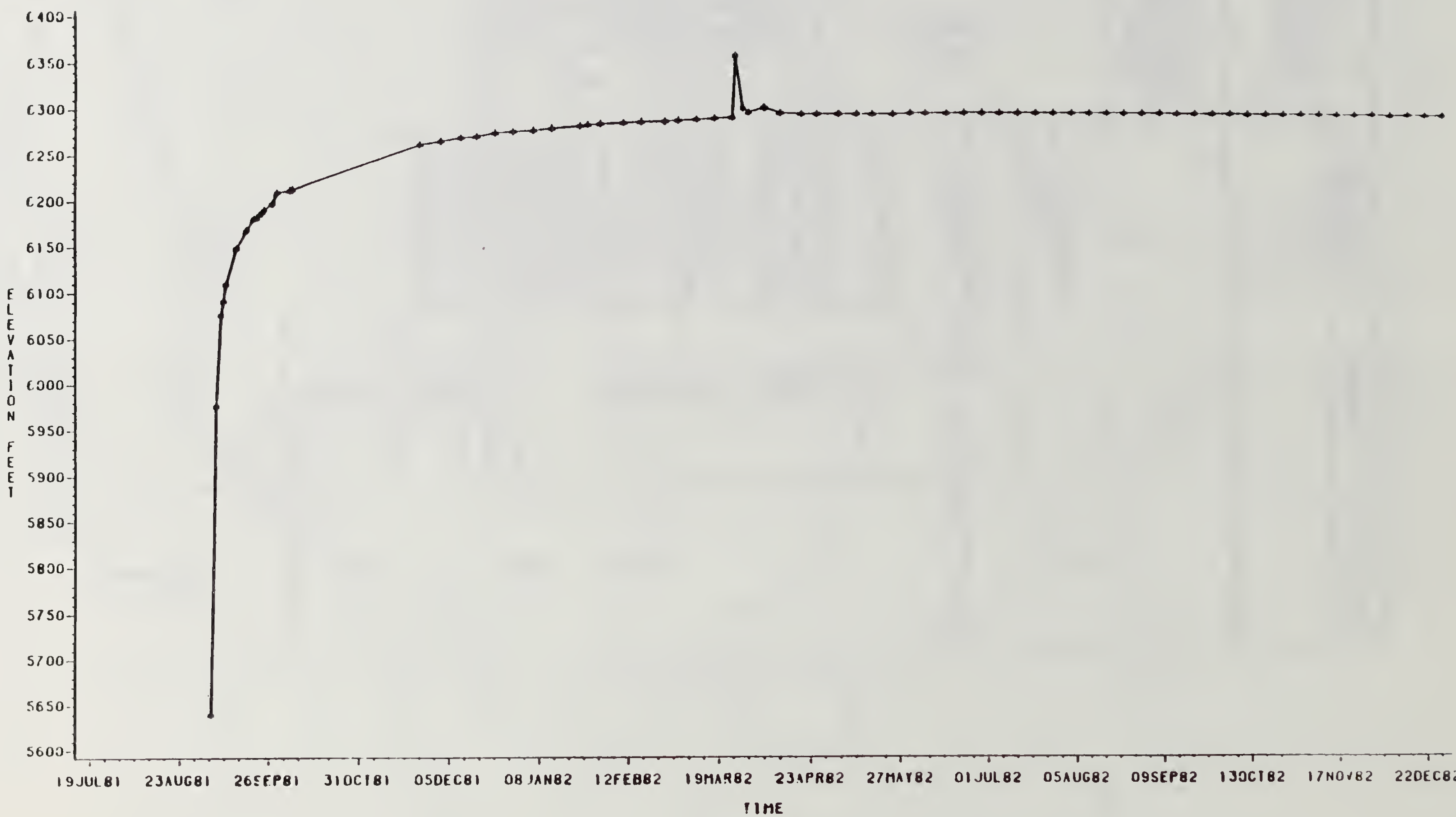


Figure 9-8

V/E SHAFT WATER LEVEL VS. TIME
(Collar Elevation = 6705 Ft.)

flow at the downstream station was 11.4 CFS. One-day minimum flows in Piceance Creek have reached less than 1 CFS. Maximum daily flows of Piceance Creek at stations up- and down-stream of the Tract are depicted in Table 9-1. In 1981 maximum flows were low because both snowpack, the rate of snowmelt, and hence, runoff were low in Piceance Basin.

Hydrographs of the up- and down-Tract stations on Piceance Creek are shown on Figure 9-9 along with the discharge of treated mine water from Ponds A/B.

With regard to groundwaters, data collected over the past three years continue to strongly suggest that the tight confining zones of oil shale highly restrict the vertical movement of groundwater between the major hydrologic units. The most significant data in this regard come from well pairs along Piceance Creek north of the Tract. A well pair consists of a deep bedrock well and an alluvial well within close proximity of one another. Interpretation of the well-pair data indicate whether or not the dewatering activities in the deep bedrock aquifers are affecting the alluvial aquifers. As shown typically in Figure 9-10, the depressurizing effects which have been detected and measured in the deep bedrock wells have not been observed to date in the alluvial companions, thus we have no evidence to date that they are hydrologically connected.

Potentiometric surfaces are shown on Figures 9-11a to 9-11d for the dates of September 1981, December 1981, April 1982 and December 1982. The contours are approximately similar. The low point is centered at the Production/Service Shafts (@ 5064 feet elevation); levels at the V/E Shaft (3700 feet distant from the Production Shaft) agree with Figure 9-8 and show levels increasing from 6182 feet elevation (September 1981) when it initially was allowed to start flooding to 6310 feet elevation at present (a rise of 228 feet). Levels at the reinjection well approximately 4000 feet distant from the Production/Service mine shafts have changed from 6581 feet elevation (September 1981) to 6419 feet elevation as of December 1982; levels there were as high as 6923 feet in December 1981. Note that reinjection temporarily terminated June 30, 1982.

The Water Augmentation Plan suggested correlations between wintertime flow in Piceance Creek with precipitation measurements in the Tract area and at Little Hills Station. Results did not correlate. Future correlations will be attempted again.

Water quality data for stations upstream and downstream from the Tract on Piceance Creek, and for stations in Stewart and Scandard Gulches are summarized on Table 9-2 by comparison with baseline. Ratios of twelve-month means for WU61 and WU07 are shown on Table 9-3.

During 1982, discharges to Little Gardenhire Gulch were made the last half of the year under the NPDES permit, and Station WU42 measured water quality affected by these discharges. All discharges in 1982 contained the high fluoride levels characteristic of the lower aquifer zones; when diluted with Piceance Creek waters the fluoride maximum value was 2.0 mg/l. On

TABLE 9-1

Maximum Daily Flows in Piceance Creek
Up- and Down-Stream of the C-b Tract

	Upstream (Sta WU07)	Downstream (Sta WU61)
Highest Recorded Daily Maximum (CFS)	157 (May 1979)	149 (May 1979)
1980 Maximum	135 (May 1980)	133 (May 1980)
1981 (Water Year) Maximum	18 (Nov.1980)	34 (Nov.1980)
1982 Maximum	29 (Aug.1982)	37 (Feb.1982)

No significant trends in streamflow have been noted other than those caused by climatic variation.

Figure 9-9

DAILY MEAN FLOW (CFS) IN PICEANCE CREEK
UPSTREAM AND DOWNSTREAM OF THE C-b TRACT AND
IN THE DISCHARGE

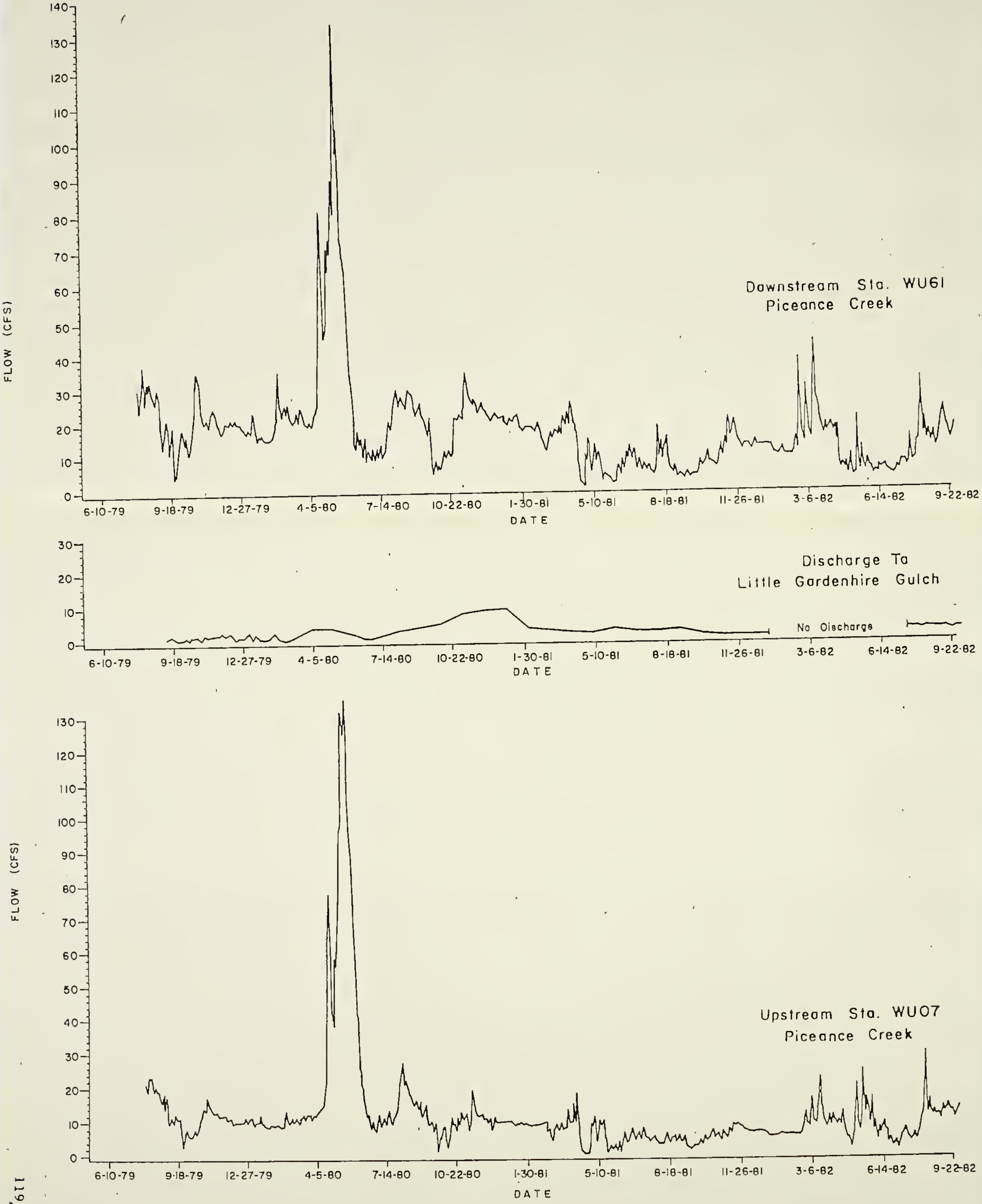
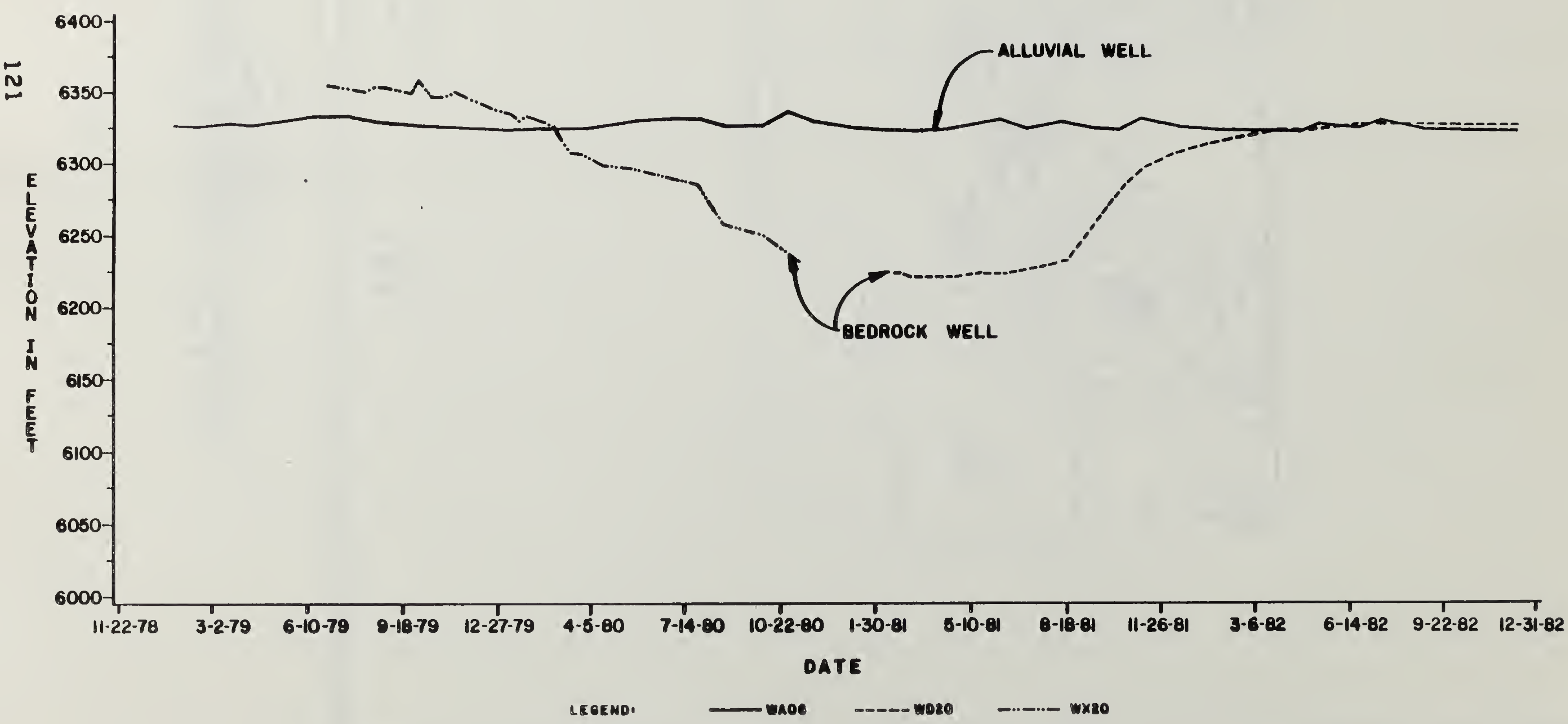


FIGURE 9-10

COMPARISION OF WATER LEVELS
IN C-b WELL PAIR DURING SHAFT DEVELOPMENT



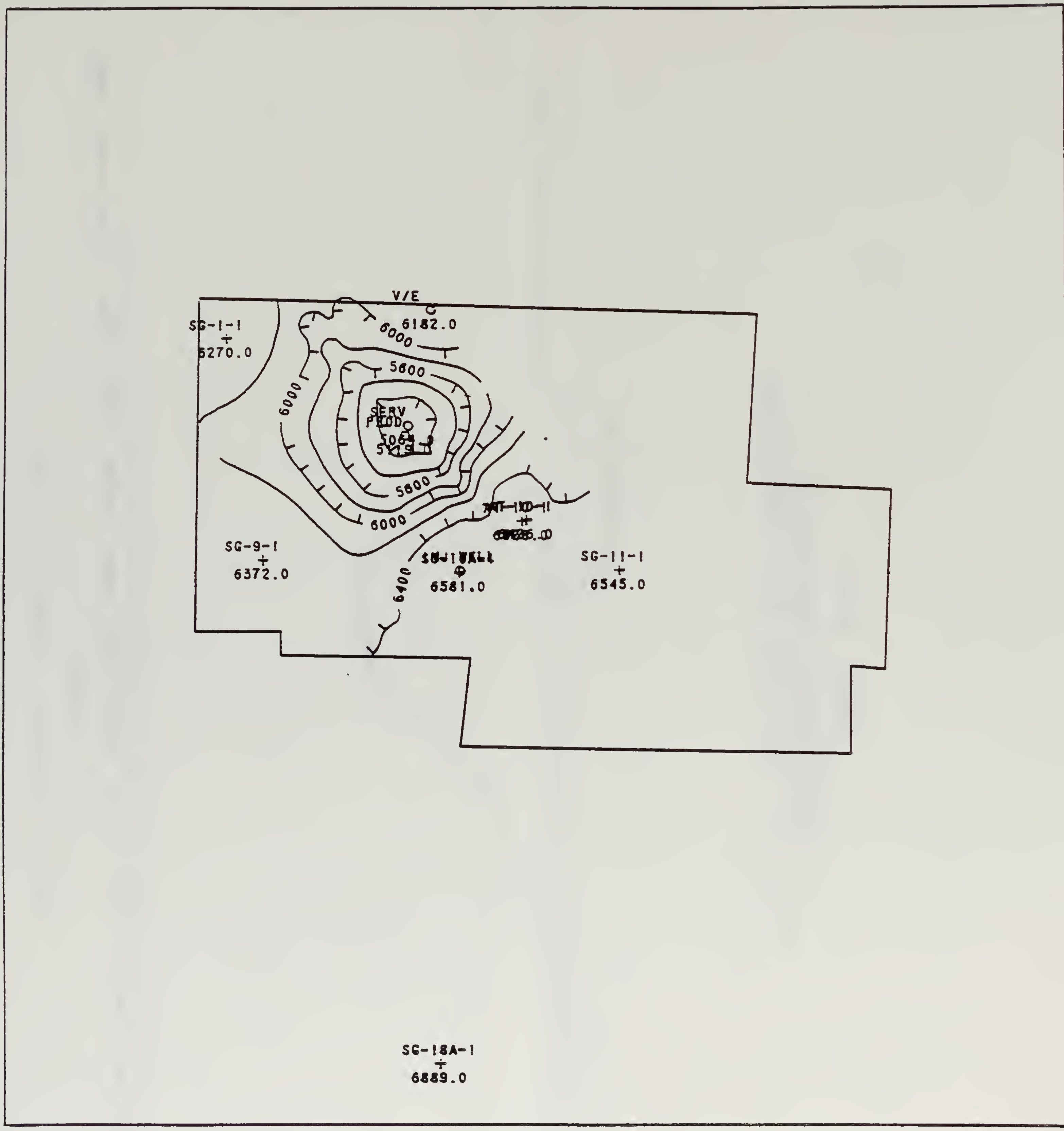


Figure 9-11a

POTENTIOMETRIC SURFACE MAP FOR SEPT. 15, 1981
LPC_3, B WELLS CNTR INT = 200.0'

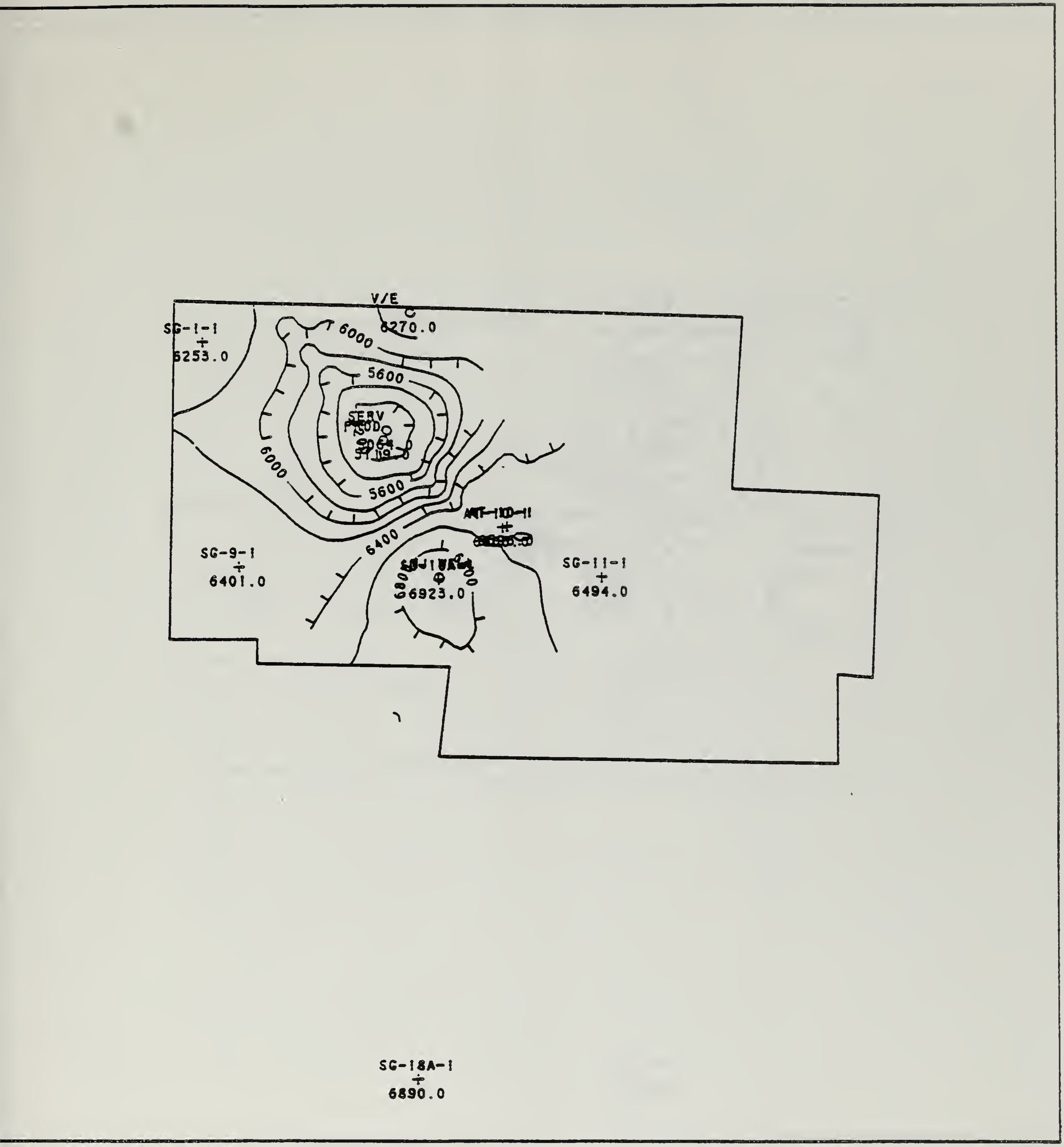


Figure 9-11b

POTENTIOMETRIC SURFACE MAP FOR DEC. 7, 1981
LPC_3, B WELLS CNTR INT = 200.0'

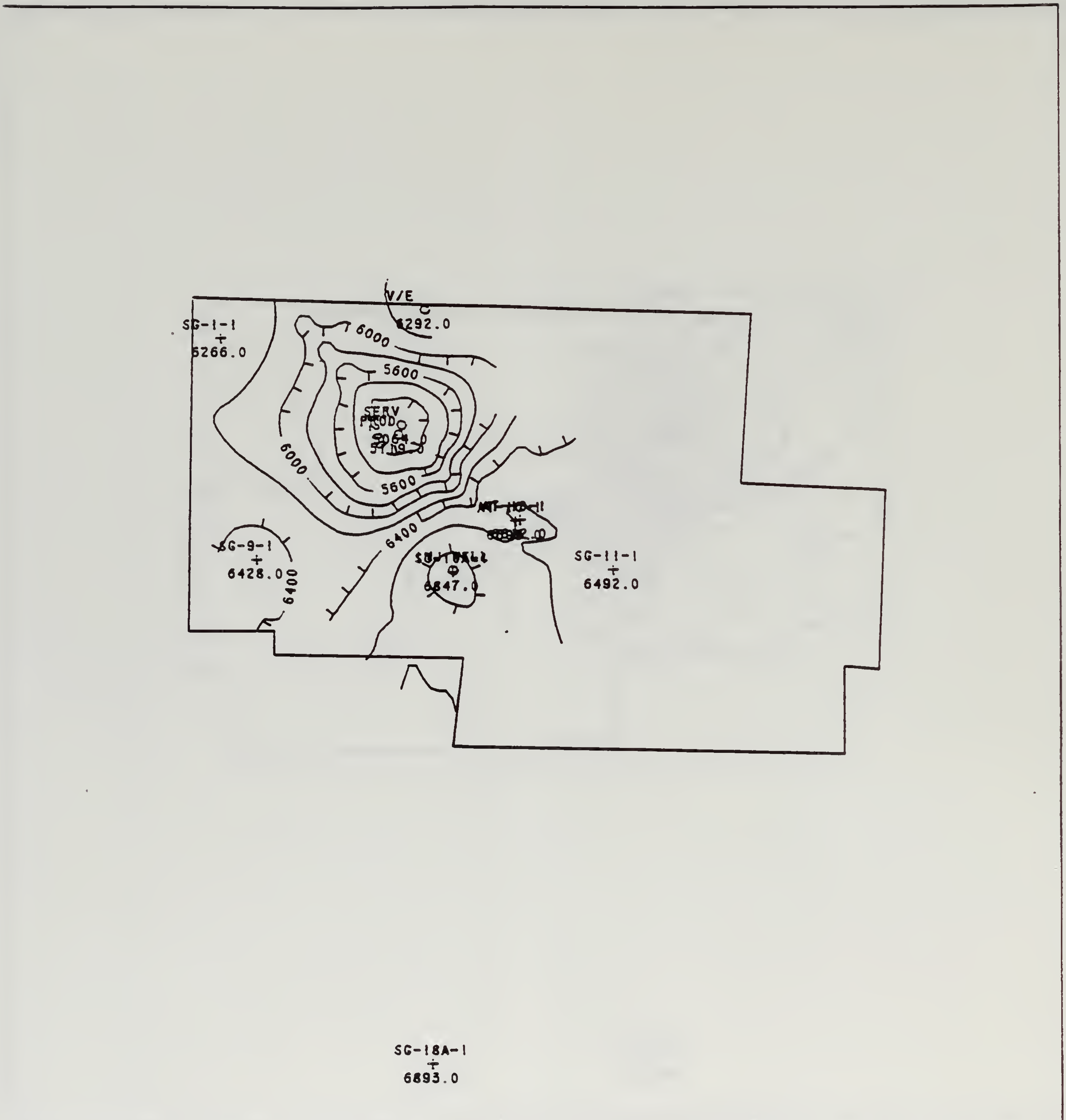


Figure 9-11c

POTENTIOMETRIC SURFACE MAP FOR APRIL 16, 1982
LPC_3, B WELLS CNTR INT = 200.0'

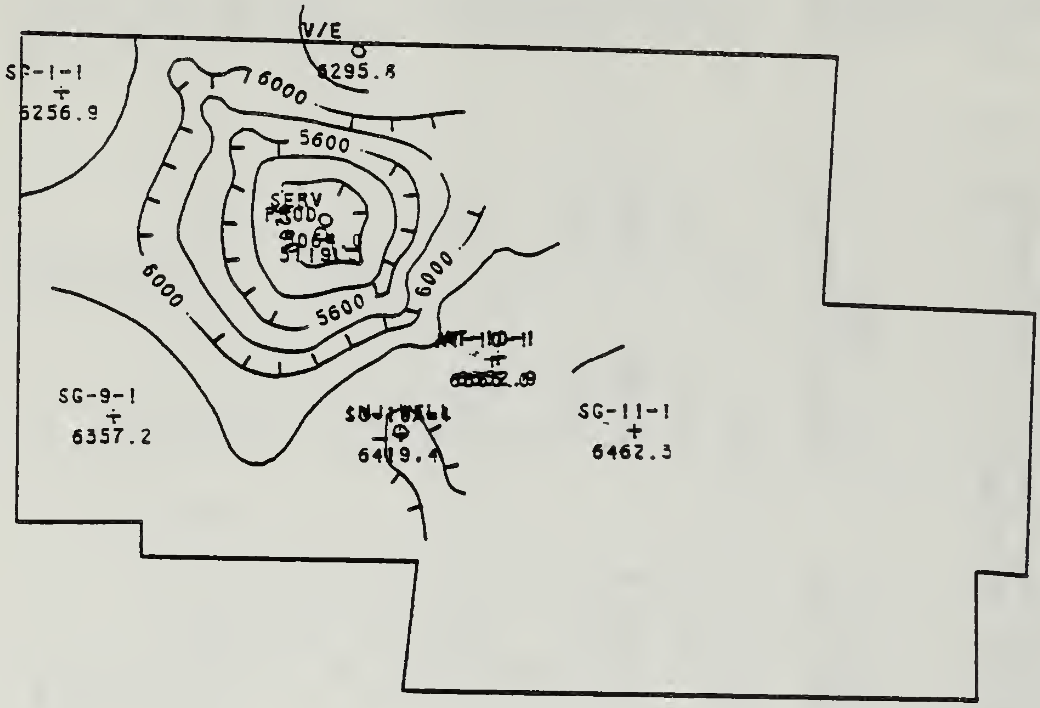


Figure 9-11d

POTENTIOMETRIC SURFACE MAP FOR DEC. 12, 1982
LPC_3, B WELLS CNTR INT = 200.0'

TABLE 9-2

Comparisons of 1982 Water Year vs. Baseline
for Mean Values of Major Water Quality Constituents
Values are in mg/l

Baselines are mean values

	WU07		WU22		WU58		WU61	
	1981-1982	Baseline	1981-1982	Baseline	1981-1982	Baseline	1981-1982	Baseline
Alk	494	422	410	403	407	402	537	465
NH_3	0.11	0.04	0.07	0.02	0.08	0.02	0.11	0.03
As	0.0023	0.0024	0.0010	0.0010	0.0010	0.0011	0.0026	0.0023
B	0.210	0.209	0.100	0.108	0.123	0.210	0.214	0.214
Ca	71	69	88	93	83	92	76	78
Cl	13	15	7.3	7.2	11.3	11.5	13	14
F	0.9	0.9	0.3	0.3	0.4	0.4	1.3	0.9
Mg	49	46	72	76	70	76	69	67
Mn(ug/l)	135	46	2	10	3	14	107	66
DOC	-	-	-	-	-	-	-	-
K	3.0	3.6	1.3	1.6	1.6	2.2	2.9	3.5
Si	16	15	16	15	15	15	17	17
Na	131	122	123	124	118	128	161	150
TDS	733	692	910	936	842	926	951	902
SO_4	181	164	355	368	317	356	311	290

Station values in 1981-1982 are for the months of 9/81 to 6/82 from USGS water data.

Baseline values are for the period 11/74 to 10/76 - from environmental baseline program.

TABLE 9-3

Downstream-to-Upstream* Ratios
of 12-Month Means, October 1-October 1

	1980-1981, WU61/WU07	1981-1982 WU61/WU07	Baseline, WU61/WU07
Alk	1.17	1.09	1.10
NH_3	1.43	1.00	0.75
As	1.03	1.13	0.96
B	1.12	1.02	1.02
Ca	0.95	1.07	1.13
Cl	0.71	1.00	0.93
F	2.23	1.44	1.00
Mg	1.26	1.41	1.46
Mn	0.47	0.79	1.43
K	1.05	0.97	0.97
Si	1.20	1.06	1.13
Na	1.43	1.23	1.23
SO_4	1.61	1.30	1.77
TDS	1.28	1.72	1.30

*Station WU61 is on Piceance Creek, downstream of the Tract;
Station WU07 is on Piceance Creek, upstream of the Tract.

an annual average basis fluoride which increased (Station WU61) from 0.8 to 2.2 mg/l in 1981 is now back to 1.3. Time series plots of fluoride and specific conductance at the up- and down-stream stations in Piceance Creek and in the discharge are presented on Figure 9-12.

For springs and alluvial and deep wells there are no significant long-term trends in water quality values for any of the major constituents. Variables examined for trends were temperature, pH, conductivity, DOC, arsenic, fluoride, boron, TDS, molybdenum, sodium, sulfate, and ammonia.

9.3.4 Aquatic Biology

Benthos and periphyton sampling was conducted in 1982 as in recent years. Thirty benthic macroinvertebrate taxa were collected from Piceance Creek in 1982. Stewart Station had 25 total taxa, Middle Station 24 and Hunter Station had 11. Generally, diversity values were low at all stations. Evenness, diversity and numbers of taxa were higher at the Stewart and Middle Stations than at the Hunter Station. Mean densities ranged from 358.8 organisms/m^2 to 25,504.1 organisms/m^2 with no consistent patterns being apparent. Siltation tends to be increasing at all stations (a flash flood at Hunter Station in late July changed the substrate composition from 40 to 90% silt) and accounts for the increases in relative abundance of Haplotaxida at all stations.

Diatoms were the most abundant periphyton sampled during 1982 with Navicula viridula var. avenacea being the dominant taxa. Total mean density values for periphyton sampling at the three stations ranged from 155 algal units/mm^2 to 20,452 algal units/mm^2. These density values showed both spatial and temporal variations. The July periphyton sample from Hunter Station was lost as a result of a flash flood.

A multitude of factors such as irrigation, livestock use, springs, flash floods, and Tract C-b water discharge may affect the Piceance Creek aquatic system. Although the 1982 study showed an increase in Oligochaeta at all stations, a comparison of station results indicated no significant difference that could be attributed to Tract C-b developmental activities. Comparisons to previous studies, including baseline conditions, also appear to rule out Tract C-b discharge as having a large effect on Piceance Creek benthic macroinvertebrates. Although statistical analysis of periphyton data does show significant differences between stations, no definite trend relating these differences of the control station (Stewart) to the station downstream of developmental activities (Hunter) was established. No discernable impact on the Piceance Creek aquatic system can be attributed to Tract C-b.

9.3.5 Air Quality

Figure 9-13 shows the air quality monitoring network. Station AB20 north of the Tract along Piceance Creek, AB23 on Tract at the 60-m meteorological tower, and AB26 south of the Tract. Under the Interim Monitoring Program AB20 was discontinued in February 1982 and AB26 in July of

Figure 9-12a

FLUORIDE CONCENTRATIONS (MG/L) IN PICEANCE CREEK
UPSTREAM AND DOWNSTREAM OF THE C-b TRACT AND
IN THE DISCHARGE

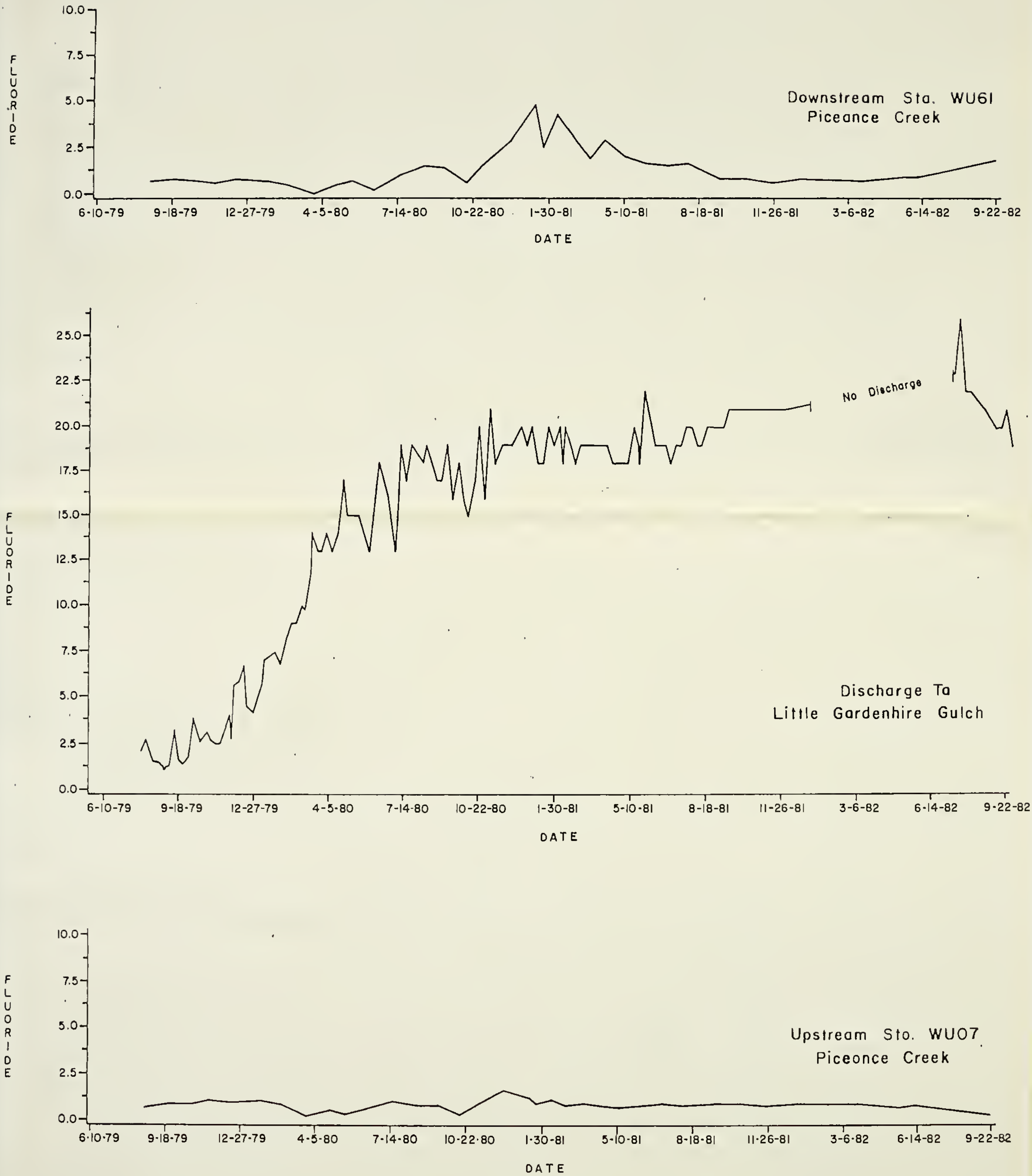
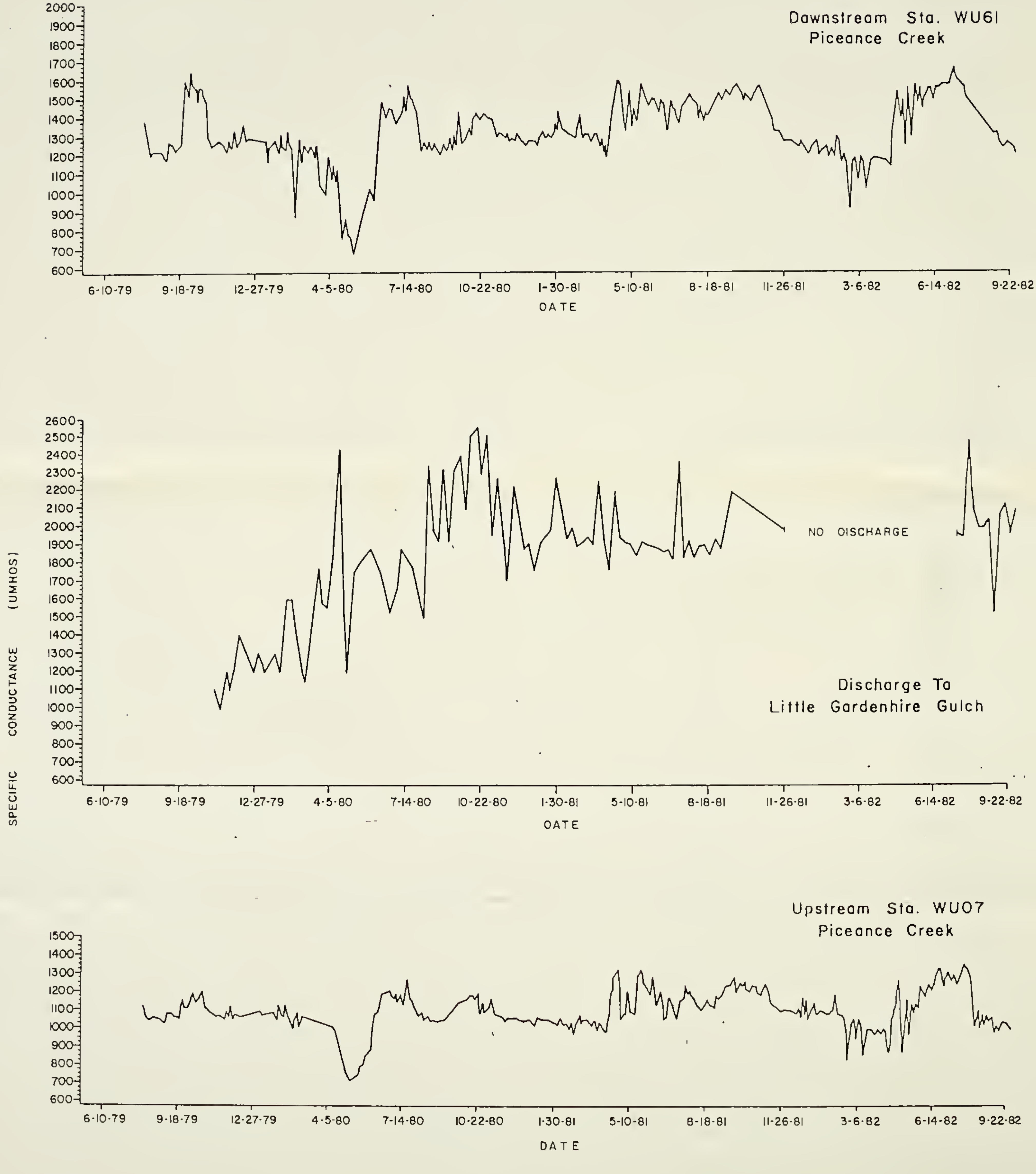


Figure 9-12b

SPECIFIC CONDUCTANCE (UMHOS) IN PICEANCE CREEK
UPSTREAM AND DOWNSTREAM OF THE C-b TRACT AND
IN THE DISCHARGE



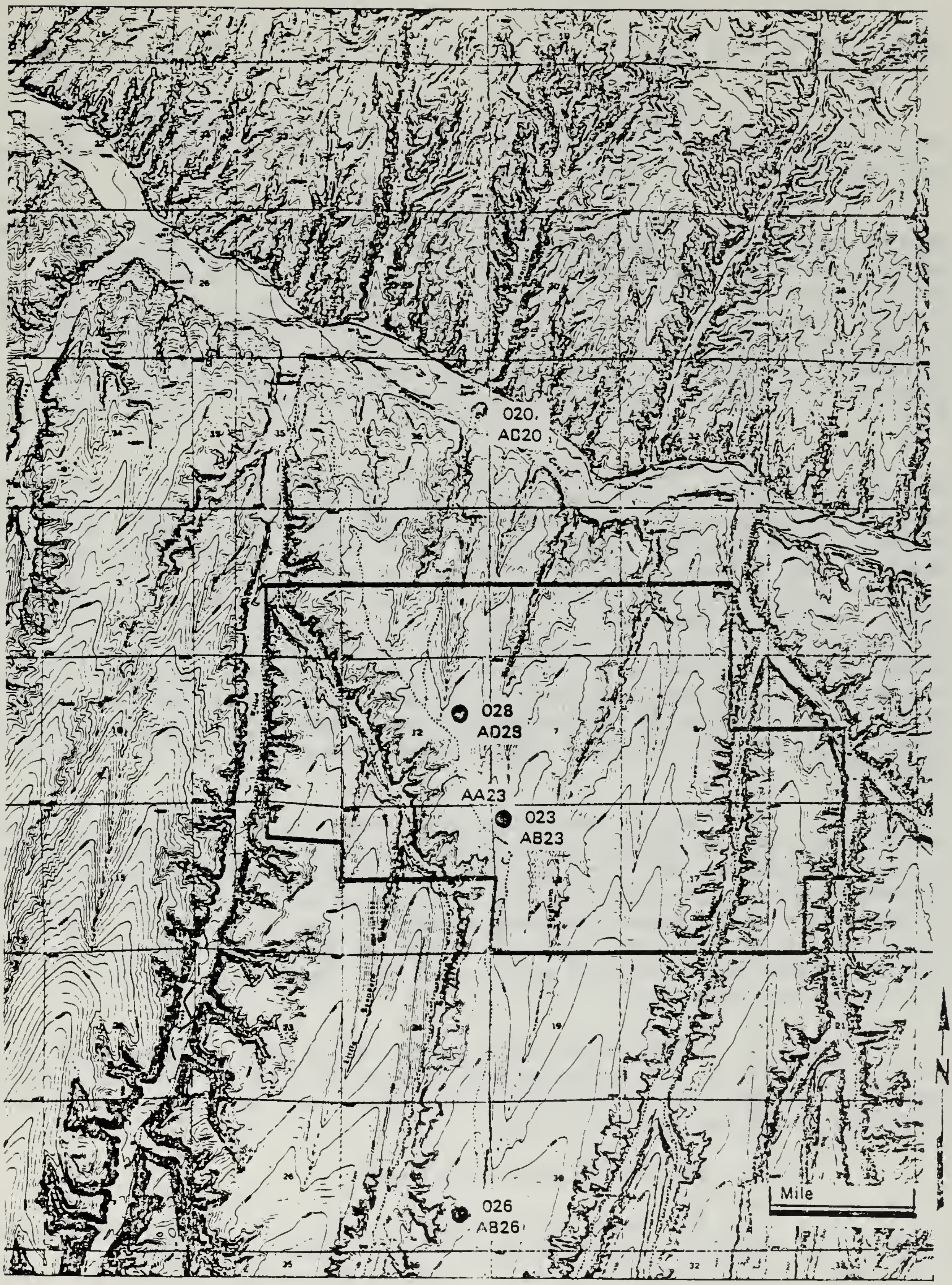


Figure 9-13

Ambient Air Quality
Interim Monitoring Network

1982. Station AB23 has monitored SO_2, NO_x, NO, NO_2, O_3, TSP, H_2S and CO continuously since 1974.

Compliance with National Ambient Air Quality Standards was achieved in 1982 as indicated on Table 9-4. Data for the most recent three year period are of most interest and are those shown.

Ozone continues to be the only air quality parameter whose ambient levels reach a substantial fraction of the air quality standard. High particulate values attributed to fugitive dust have been noted. Reports of previous years substantiate that high ozone readings are due in part to long distance transport from downwind urban centers, to subsidence associated with passage of storm fronts and possibly due to natural hydrocarbons from neighboring vegetation. The annual ozone rose (concentrations by wind direction) is shown on Figure 9-14. That for particulates is given on Figure 9-15.

Possible linear trends in air quality variables over time have been examined for the 1982 time period (called short-term) and since baseline (long-term) and are summarized in Table 9-5. Entry number 2 for each variable is the computed level of significance; if it is less than the selected level of 0.05, a trend exists at this level of significance. Entries 3 and 4 are shown only where significant trends exist, from a statistical point of view. Practically speaking, only the long-term negative trend for CO (-0.38 $ug/m^3/day$) is significant. Higher readings during baseline and shortly thereafter were obtained utilizing a relatively inaccurate instrument. There have been two additional instrument replacements since that time with lower values being recorded in the near-recent past, contributing to the negative trend. Restated, the trend for CO is judged to be an artifact of changing instruments.

Quality assurance audits were conducted quarterly in 1982. The first two were conducted by the Grand Junction staff of the Environmental Services Department. The third was conducted by the State of Colorado; all instruments were within the $\pm 10\%$ goal for this audit. That is, the slope of the regression line between the audit device and that being audited was $1.0 \pm <0.1$. The fourth audit was conducted by the EPA Region VIII contractor. All instruments were within the 10% goal except SO_2; SO_2's slope was 0.89 or 11% from perfect agreement.

Visual range measurements varied from a maximum mean daily value of 177 miles in the Spring to a minimum of 58 miles in the Fall. See Table 9-6. No substantial changes in mean visual range have occurred since the implementation of the program in 1975.

9.3.6 Meteorology and Microclimate

No unusual meteorological readings or trends were observed in 1982. One principal use of the meteorological data was to obtain Pasquill-Gifford atmospheric stability and wind persistence information for use

TABLE 9-4

Comparisons of Maximum Background Levels with National Ambient Air Oualilty Standards (Station AB23)

Applicable Standard	Constituent	Averaging Time	Standard Limit (ug/m3)	Maximum Reading (ug/m3) 1980	1981	1982
Primary	SO_2	Annual	80	1.0	1.5	1.4
		24-Hour	365	11.9	17.3	13.0
Secondary	SO_2	3-Hour	1300	13.1	18.3	15.7
Primary	NO_2	Annual	100	1.0	10.3(1)	2.7
Primary	Particulates	Annual	75*	8.3	12.5	10.8
		24-Hour	260	58.4	86.2	51.4
Secondary	Particulates	Annual	60*	8.3	12.5	10.8
		24-Hour	150	58.4	86.2	51.4
Primary	CO	8-Hour	10,000	3000	1800	200
		1-Hour	40,000	3800	1800	600
Primary	Oxidant (O_3)	1-Hour	240(2)	154	155	143

*Geometric Mean
(1) <50% Data
(2) Standard is exceeded if $\geq$ 3 expected exceedances occur above this value over a three year interval.

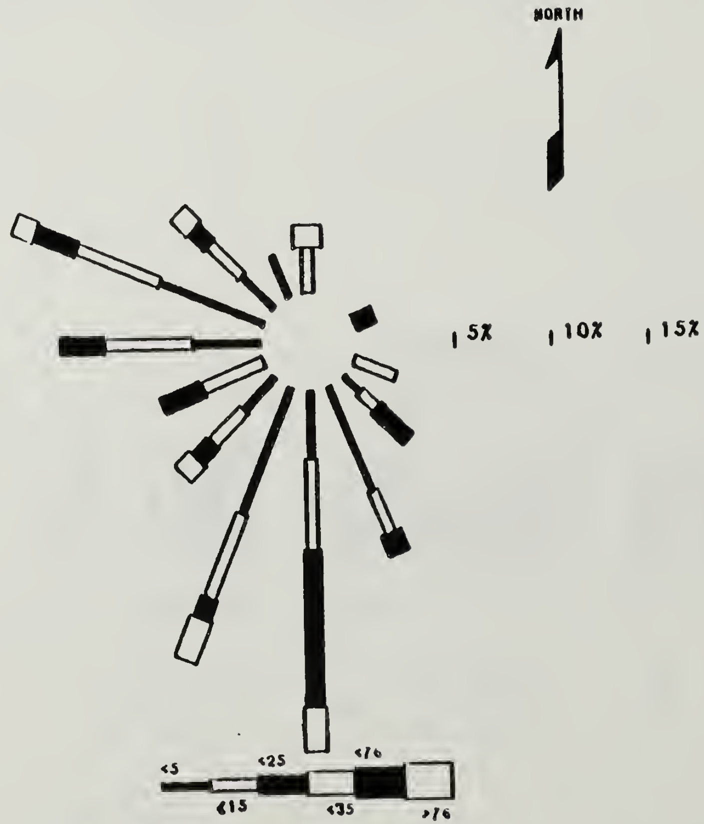
Figure 9-14

AB23 ANNUAL OZONE CONCENTRATION ROSE
JAN '82 - DEC '82

TOTAL % OF CALMS DISTRIBUTED (1.85%)
TOTAL NO. OF 1-HOUR SAMPLES - 7527

Figure 9-15

AB23 ANNUAL TSP CONCENTRATION ROSE
JAN '82 - DEC '82



Concentration (ug/m^3)

TABLE 9-5

SUMMARY OF AIR QUALITY TREND ANALYSIS, STATION AB23

Indicator Variable	Short-Term*	Long-Term**
NO_x	1. 2.68/327	1.45/2519
	2. 0.0001	0.29
	3. -0.0161	
	4. 0.48	
NO	1. 1.31/327	0.88/2560
	2. 0.0001	0.17
	3. -0.0102	
	4. 0.60	
NO_2	1. 1.43/330	0.80/2522
	2. 0.0001	0.0001
	3. -0.0056	0.0002
	4. 0.20	0.01
O_3	1. 35.03/330	37.33/2834
	2. 0.0001	0.0001
	3. -0.0156	0.0014
	4. 0.08	0.01
CO	1. 14.81/355	290.79/2413
	2. 0.0001	0.0001
	3. -0.0448	-0.38
	4. 0.06	0.36
SO_2	1. 0.58/357	0.37/2809
	2. 0.24	0.0001
	3.	0.00009
	4.	0.008
H_2S	1. 0.98/354	0.55/2665
	2. 0.93	0.17
	3.	
	4.	

1. Mean/Number of paired observations
2. $\hat{\alpha}$ - to be compared with selected α. ($\alpha = 0.05$); if $\hat{\alpha} < \alpha$, trend exists
3. Slope - slope is ($\mu g/m^3$) per day
4. r^2 value

* 1982
** 1975 - 1982

TABLE 9-6

Statistical Summary for 1982 Visual Range Study

Season/View	No. Observations	VISUAL RANGE* Minimum	Maximum	Mean	Standand Deviation
Spring I	10	80.6	168.8	111.0	23.9
II	10	77.1	166.5	105.8	24.1
III	10	67.7	177.3	107.4	29.2
IV	10	76.1	182.0	113.7	28.0
All views	40	67.7	182.0	109.3	26.4
Fall I	11	63.4	85.4	74.5	6.7
II	11	58.2	84.7	74.2	7.5
III	11	63.5	84.2	74.0	6.1
IV	11	59.4	88.1	77.0	7.7
All views	44	58.2	88.1	74.9	12.7
Yearly	84	58.2	182.0	92.6	25.7

* Data are shown in miles.

in air diffusion modeling in conjunction with the Prevention of Significant Deterioration (PSD) permit application in December 1982.

Regarding microclimate, the four stations which are being monitored during the Interim Monitoring period are: BC03, BC05, BC07, and BC09. Time series plots for 1982 microclimate data are presented in the January 1983 Data Report. Observations from comparing 1982 data to previous years (1975-81) are:

- o Below freezing temperatures were noted during the growing season but temperature ranges were similar to previous years.
- o As in the past years, snow depths were the highest during January and February (20.1 cm-mean). The four year mean is 25.6 cm for these four stations.
- o Precipitation for the summer months was higher than the 8 year average (26.2 cm vs 18.5 cm). This precipitation rate was the second highest recorded rate since 1975.

9.3.7 Noise

The environmental noise program was discontinued during the Interim Monitoring period.

9.3.8. Wildlife Biology

Wildlife studies were performed during the 1981-82 period on mule deer, lagomorphs, small mammals, raptors, and browse. See the January 1983 Data Report for results and discussion sections of the wildlife studies and jacket map of the biological sampling program stations (Figure 4.3-1 of that report). After analyzing all the wildlife studies no disturbance effects (impacts) of biological importance were identified.

Results of mule deer pellet-group counts indicate no appreciable displacements of deer indicative of major impacts. Deer pellet group densities were higher in 1981-82 than in 1980-81 (345 vs. 275 pellet groups/acre). Since the pellet counts were started in 1974 the deer pellet group densities have varied from as high as 431 pellet groups/acre in 1979-80 down to 242 pellet groups/acre in 1978-79.

Percent utilization of bitterbrush by deer was higher in 1981-82 than the previous year (82% vs. 73%). The browse utilization was quite uniform over both the chained rangeland and pinyon-juniper habitat. Usually the chained rangeland has a slightly higher utilization rate than the pinyon-juniper habitat. The uniform rate this year might be the result of the mild winter and lack of snow, allowing the deer better access into pinyon-juniper habitat. The highest rate was almost 90% in 1977-78. The suggested acceptable utilization rate of bitterbrush is 50% (Shepard, 1971) with 80% use resulting in damaging and killing of the shrubs.

There seem to be several interesting trends starting to appear with the sagebrush estimates. Comparing yearly data, sagebrush ocular estimates are showing a decrease in the heavy utilization category with a corresponding increase in the low utilization rate. Also, the estimates are showing an increase in young plants and a decrease of decadent plants. It seems that sagebrush age class and utilization rates may be responding to deer herd size. When the deer herd was large, utilization was high with many decadent plants present. Now that the herd size has dropped the utilization has decreased and the number of young sagebrush plants is increasing. It could be possible that the sagebrush study may be a better indicator of herd size than previously thought. These possible trends will be monitored closely.

The mule deer phenology and distributional patterns showed a high Fall count of 306 deer and a Spring count of 809 deer. The 1981-82 accumlative road count was almost three times as high as the 1980-81 count (6769 deer vs. 2373) indicating an increase in herd size. The highest accumulative road count was recorded in 1978-79 (12815 deer). Comparisons of these results with previous years' findings indicates no displacement of deer due to developmental activities.

Fifty-four deer were killed along the Piceance Creek Highway in 1981-82 field season as compared to 28 deer in the previous year. This increase is probably due to the increase in herd size since traffic volume was less than last year. As in previous years, highest kills were the does, followed by fawns and then adult bucks.

The 1981-82 winter was fairly mild and this was reflected in the natural mortality study. Only two carcasses were found. This is the lowest mortality since the study was initiated in 1974.

Results of the age-class composition study showed an 81.8 fawn per 100 adult age ratio preceding the winter. The spring survival rate was 61.1 fawns per 100 adults, which is the highest survival estimate recorded since 1978.

Interrelationships of deer pellet-group data and bitterbrush data suggest that percent utilization of bitterbrush is a good quantitative indicator of impacts to deer herd size. A multivariate design that incorporates pellet-group and bitterbrush measurements may be used for future exploratory analyses. When data from all the deer studies (i.e. high road counts, high pellet group counts, high fawn survival, high bitterbrush and sagebrush utilization rates and low mortality counts) are combined it indicates that the Piceance Basin deer herd is increasing.

Cottontail rabbit data were summarized for the past four years. The 1981-82 transect means (number of quadrats with cottontail droppings present/total number of quadrats) for chained rangeland was 7 compared to 11 for pinyon-juniper habitat. The four-year mean average shows more cottontails using the pinyon-juniper habitat than chained rangeland (11 vs. 9.2). Although no definite trends were evident, a comparison of cottontail abundance in sagebrush brush-beaten sites with control sites suggests that brush-beating might have negative effects on cottontail habitat.

The results of a new sampling technique for small mammals, which was designed this year to evaluate the sensitivity of the present method for detecting changes in population size, suggest that rather small changes can be statistically detected. (See 1983 Data Report for study design changes). A least significant difference (LSD) was calculated ($1.965 \sqrt{2(.003)/10} = 0.048$) to recognize differences in abundance levels between the impact and control areas. Results showed that declines of only 2.3% for deer mice and 7.4% for least chipmunks could be identified at the 95% confidence level. The results of attempts to evaluate the eight selected habitat features as predictors of small mammal abundance showed that none of the features measured were correlated with capture frequencies. The homogeneity of the habitat stratum sampled was probably the major cause of these results.

Results of the raptor nesting study showed six active nests having young present. The nestings consisted of two pairs each of golden eagles, red-tailed hawks and great-horned owls. The raptor population seems to be fairly stable in the study area.

Analysis of the wildlife data indicate that Tract C-b developmental activities have not significantly affected the various wildlife species using the Tract. The species seem to be using the habitat much as they did during the pre-development period (1974-77). In fact, less than 200 acres have been disturbed since 1978. This factor of not seeing any appreciable effects on wildlife by developmental activities seems to indicate that we are still collecting pre-developmental data and, until large scale development starts, we will continue to collect baseline data.

No threatened or endangered plant species were observed on Tract C-b. Bald eagles and sandhill cranes were again observed in the general tract vicinity (5 sandhill cranes were on the aquifer test pad for 1/2 hour). Two species on the list for possible threatened and endangered status were seen. A Swainson's hawk was observed up Hunter Creek and a long-billed curlew was seen on Tract.

9.3.9 Vegetation

Vegetation monitoring studies have been conducted yearly on the C-b Tract since 1977. In 1982 the monitoring studies were scaled down in conjunction with a delay in construction activities. The studies which were conducted were the production/utilization measurements in the chained-rangeland type, the irrigation and fertilization production studies, the cover and density studies in the irrigated chained-rangeland intensive-study plot, an estimate of vegetative cover for the revegetation of the raw shale demonstration plot, annual herbaceous production for the brush beating study, and chemical analysis of the soils and vegetation from the irrigation area. Basic data are contained in the January 1983 Data Report.

The 25 permanently located quadrats within the irrigated chained-rangeland plot were sampled in 1982 using the same methods used in earlier years. The major species in the irrigated chained-rangeland plot are western wheatgrass (Agropyron smithii), cheatgrass (Bromus tectorum), and

Indian ricegrass (Oryzopsis hymenoides). These three species account for more than 43 percent of the cover in the plot. Total cover by herbaceous species was 8.8 percent in 1982; litter covered 69 percent of the ground layer; and bare soil cover was 21 percent. Over the past three years of sampling, there have been only minor changes in the frequency values for the herb layer species. The most noticeable changes have been for annual species, which tend to fluctuate yearly depending on the amount of moisture available for growth. Some changes can also be seen in the frequency values for perennial grasses. This is especially true for the wheatgrasses (Agropyron spp.). These differences probably relate to problems in identification rather than actual changes in the presence of these species. Total herb layer cover decreased in 1982 compared with both 1980 and 1981 (Table 9-7). Litter cover also decreased; however, cover by bare soil increased. These differences are either related to actual differences in the herb and ground layer structure or to differences in observer estimates. The differences are not great enough to be certain what their causes may be.

Total shrub density was 4141 shrubs per hectare, and mean cover was 13.9 percent. The major species is big sagebrush (Artemisia tridentata). Over the past three years few changes have been observed in the shrub layer data. Mean cover was 13.0 percent in 1980, 14.1 percent in 1981, and 13.9 percent in 1982. Total density for the same years was 2985, 3766, and 4141 individuals per hectare, respectively. In 1982 only 16 of the 20 shrub lines were sampled. The higher density in 1982 may be a result of the difference in sample size.

In 1982 production and utilization studies were limited to the chained-rangeland vegetation type. Data were obtained in both the irrigated and non-irrigated areas.

In the chained-rangeland type the mean total production was 23.6 g/m^2 (210 lbs/ac) in the open areas and 41.7 g/m^2 (372 lbs/ac) inside the range cages. Based on a one-way analysis of variance these two means are significantly different at an 0.05 level of significance (Table 9-8). In the irrigated chained-rangeland type the mean total production in the open areas was 29.4 g/m^2 (262 lbs/ac) and 77.0 g/m^2 (686 lbs/ac) inside the range cages. This difference in production was also significant (Table 9-8). In both the irrigated and non-irrigated areas, perennial grasses accounted for most of the production.

Based on data from the non-irrigated range cages, the production in the chained-rangeland type was comparable to the results obtained in earlier years (Figure 9-16). Over the past four years, production has ranged between approximately 42 and 46 grams per square meter (374 and 410 lbs/ac).

The sampling for the irrigation/fertilization study in 1982 was the same as that used in 1981.

Fresh weight estimates and oven dry weights were used in conjunction with the regression equations to obtain oven dry weight estimates

Table 9-7 Mean cover and species diversity summaries for herbaceous quadrat studies at the irrigation intensive study plot.

	Mean Cover		
	1980	1981	1982
Herb Cover	10.0	14.4	8.8
Woody Cover	0.3	0.6	0.6
Mosses	0.1	0.2	0.1
Crustose Lichen	0.5	0.4	0.2
Litter	80.0	84.2	68.7
Bare Soil	15.7	12.5	20.8
Rock	3.8	3.1	3.1
Mean No. of Herb Species per m^2	8.1	8.2	8.1
Mean Total No. of Species per m^2	8.6	9.0	9.3

Table 9-8 One-way analysis of variance results evaluating effects of grazing utilization and influence of irrigation. Underlined items in paired tests are those with the greater mean value. 1982 data.

	Calculated F	ν_1	ν_2	Critical Region $\alpha = 0.05$	Significance
DIFFERENCES IN UTILIZATION					
Chained Rangeland Open vs. <u>Chained Rangeland Fenced</u>	9.36	1	28	4.21	SIG
Irrigated Chained Rangeland Open vs. <u>Irrigated Chained Rangeland Fenced</u>	26.02	1	28	4.21	SIG
EFFECTS OF IRRIGATION					
Range Cages Chained Rangeland vs. <u>Irrigated Chained Rangeland</u>	12.02	1	28	4.21	SIG
Open Areas Chained Rangeland vs. <u>Irrigated Chained Rangeland</u>	1.06	1	28	4.21	NS

SIG = Significant

NS = Not Significant

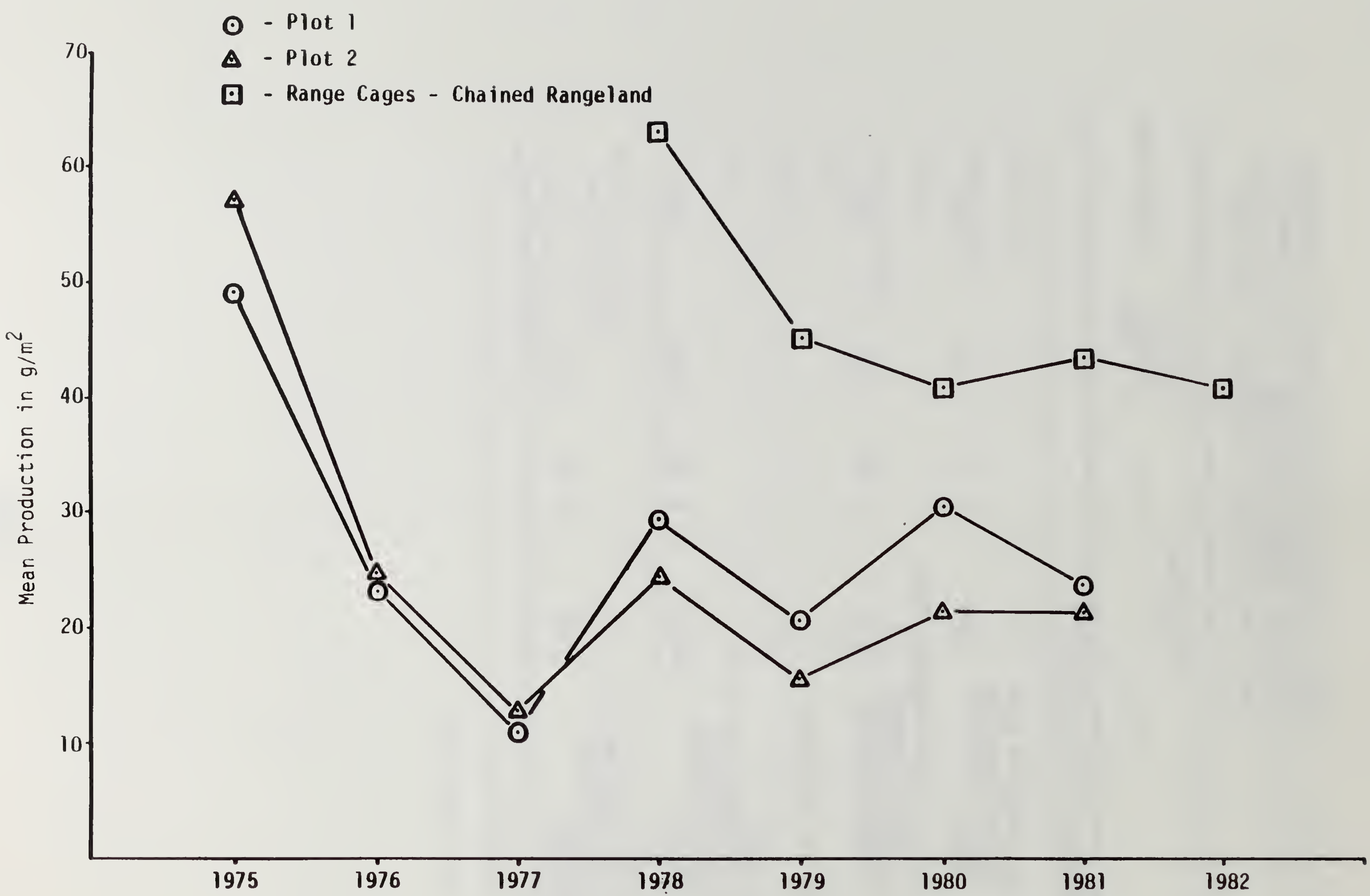


Figure 9-16 **Trends in mean herb production between 1975 and 1982 for chained pinyon-juniper rangelands.**

for all samples. The data are presented in the January 1983 Data Report; Section 2.5.3. There are no clear trends shown in the mean production values for the various fertilization treatments. Mean values ranged between approximately 2.0 and 2.6 g/0.1m^2 (178 and 232 lbs/ac). The effects of fertilization rate, irrigation, and fertilization application frequency were evaluated using a three-way analysis of variance. There were no significant differences in the mean production values that could be attributed to irrigation, fertilization rate, or fertilization application frequency. Also, none of the interactions of the above factors were significant (Table 9-9). During the 1982 growing season, livestock grazing on the irrigated area was mostly continuous throughout the summer. The continuous utilization of the herbaceous production has apparently masked any fertilization or irrigation effects. In 1981 significant differences were noted relative to each of the three above factors. These measured significant differences did not occur during 1982. It is possible that the fertilizer effects are still causing increases in production. Because of the utilization by livestock, these differences, if they occur, were not noted.

The irrigated areas (inside the range cages) were significantly more productive than the non-irrigated chained rangelands (Table 9-8). The difference between the open areas, however, was not significant. Based on this, it is possible to see the influence of grazing. The livestock apparently grazed all areas heavily enough to mask any other treatment effects.

Revegetation analysis consisted of obtaining an estimate of vegetative cover for the revegetation of the raw shale demonstration plot. This year's data represent the results from the first growing season. An estimate of cover was obtained for each topsoil cover depth (18 inches, 12 inches, and 6 inches). The estimated vegetative cover ranged between 7% and 8% for all depths.

The sampling for annual herbaceous production for the brush beating project showed similar results to the previous two years. The two gulches where the brush was knocked down had higher production than the control area; however, the difference was not as great as in previous years. The annual production was slightly higher for all areas in 1982 than 1981.

A chemical analysis of the soils and vegetation was conducted in 1982 in the area that was sprinkler-irrigated during 1980 and 1981. The sampling and analysis procedures as well as the specific parameters were the same as previous years. Results of the analysis indicate that there should be no toxicity problems encountered for either the vegetation or soils.

9.3.10 Ecosystem Interrelationships

Ecosystem interrelationship studies are continually being conducted for two reasons: 1) to determine the potential impact of environmental perturbations resulting from development activity and 2) to quantify relations between biotic and abiotic variables.

Table 9-9 Results of the three-way analysis of variance test for evaluating the effects of fertilization rate, irrigation rate and fertilization frequency. 1982.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Calculated F	Significance*
Subgroups					
A Fertilization Rate (FR)	2	0.20	0.10	0.096	NS
B Irrigation Rate (IR)	1	0.10	0.10	0.096	NS
C Fertilization Frequency (FF)	1	0.07	0.07	0.067	NS
Interactions					
A x B (FR x IR)	2	5.85	2.92	2.810	NS
A x C (FR x FF)	2	0.42	0.21	0.202	NS
B x C (IR x FF)	1	0.24	0.24	0.231	NS
A x B x C (FR x IR x FF)	2	3.60	1.80	1.732	NS
Within (Error)	168	174.60	1.04		
Total	179	185.08			

*SIG = Significant

*NS = Not Significant

$F_{0.05\ [1,\infty]} = 3.84$, $F_{0.05\ [2,\infty]} = 3.00$

This year several ecosystem interrelationships were examined at a qualitative level to determine if the relationship was strong enough, and if enough data were available to perform quantitative analyses. On this basis, three relationships emerged for further study:
1) a comparison of the variability between estimators of deer density;
2) that between snow depth and deer road kill; and
3) that between vegetative production and amount of surface water received, both as rainfall and from sprinkling excess mine water in designated areas.

9.3.10.1 Interrelationships between Deer Density Indicator Variables

Four indicator variables are used to estimate deer density. These include browse production, browse utilization, hedging, and deer pellet-group densities. Coefficients of variation (CV) for each of the variables listed above were calculated to determine the amount of variability within each measurement, with the following results:

	Coefficient of Variation	
Measurement	Chained Rangeland	Pinyon-Juniper
Percent Browse Utilization	10.3	14.7
Browse Production	35.9	29.5
Hedging	64.9	66.3
Deer Pellet-group Densities	85.2	107.7

The deer pellet-group densities measurement has a high coefficient of variation, however this measurement is still considered valuable as it provides data on deer abundance and distribution. Furthermore, pellet-group counts require comparatively little sampling time which allows a greater area to be sampled. Every year there have been very weak within-year correlations between pellet-group counts and percent utilization. Since deer do not necessarily defecate and feed in the same spot, correlation between pellet-group counts and utilization percentages may be low. Correlations could be increased if the species sample size were increased to sample a major portion of the entire habitat patch.

9.3.10.2 The Relationship Between Snow Depth and Deer Road Count

Linear regression analyses performed in previous years on deer road kill vs. deer road count and vehicle count have yielded no linear correlations. Preliminary observations indicate that snow depth is a strong influencing factor on deer road kill. This is logical since the deep snow should force the deer down along the roadsides, thus making them more vulnerable to vehicle collisions. Linear regression analysis tested this hypothesis.

Deer spend a majority of time in winter on south-facing slopes, and move into valley bottoms in the spring to take advantage of early spring growth. Therefore, snow depth data from microclimate stations BC08 (bunchgrass community, south-facing slope), BC07 (chained

pinyon-juniper rangeland), and BC09 (valley-bottom sagebrush) were used in the analysis. Snow-depth data from the onset of winter snowfall through February were used. It is felt that snow depth is not the major influencing factor keeping deer near roadsides in early spring (March-April); at that time they are presumed to be feeding on early spring growth in the valley bottoms. Also it is unlikely that snow depth prior to November would influence deer road kill as it is not deep enough to force migration before that time; therefore data after November 1 were used.

Strong linear correlation was found using snow depth data from microclimate Station BC08, located in the habitat type where the deer concentrate most ($\alpha = 0.01$, $r^2 = 0.98$). When data from stations BC07 and BC09 were used, the significance level drops to 88% for BC07 and 91% for BC09. Strength of correlation was still high for these stations ($r^2 = 0.77$ for BC07, $r^2 = 0.82$ for BC09). Thus results from this initial analysis indicate that snow depth is affecting deer road kill from November 1 - March 1 and therefore this study will be continued in subsequent years.

9.3.10.3 The Relationship Between Vegetative Production and Amount of Water Received

Linear correlation studies in past years have shown that a relationship exists between vegetative productivity and amount of precipitation received during the current growing season, also between vegetative productivity and the amount of precipitation received during the previous growing season. It is therefore reasonable to assume that, if precitation were significantly increased by irrigation, vegetative productivity would also be increased significantly during the same year that irrigation occurred and for at least one year following irrigation. Comparisons of productivity data from 1981 (year of irrigation) and 1982 (year following irrigation) for the irrigated area vs. similar areas which received no irrigation seem to support this assumption.

To test the above hypothesis, linear regression analyses were performed on herbaceous productivity vs. the amount of precipitation received during the current growing season and the amount of precipitation received during the previous growing season. The amount of water sprinkled on the irrigation area was included in the total 1981 precipitation for that area.

Results of these analyses showed linear correlations do exist, within a 99% level of significance. Strength of correlation was slightly higher for production vs. current year's precipitation ($r^2 = 0.46$) than for production vs. previous year's precipitation ($r^2 = 0.40$). These results indicate that there is a "lag" effect from irrigation on herbaceous production of at least one year, but that effect is not as significant as the effects from irrigation during the same growing season.

9.3.11 Items of Aesthetic, Historic, or Scientific Interest

Surface activity was limited in 1982 so that minimum impact on aesthetics occurred. Good "housekeeping" is monitored by regular site inspections of the OSO and by consistent alertness of the environmental on-site staff. Temporary buildings, no longer in use, are dismantled and removed as delineated on Table 4-2.

9.3.12 Health and Safety

Accident frequency analyses are included in the semi-annual data reports to the DMM-OS. At C-b based on 322,468 man-hours, there were 5 lost-time accidents. The site injury (incident) rate in 1982 was 3.10 (reportable accidents x 200,000/man-hours). This compared with 22 lost-time accidents in 1981, and an injury rate of 7.53.

9.3.13 Toxicology

Toxicological testing further to that conducted in 1981 was curtailed during 1982 because of reduced on-site activity and budget. A continuation of the program under the direction of Dr. Paul Nees is being planned for the future.

9.3.14 Data Management and Quality Assurance

Air data are incorporated in a computerized data base management system called RAMIS. The basic data report generated is a diurnal table of hourly-average values for each variable, excepting particulates which are measured every fourth day as a daily average. Monthly air reports are generated and incorporated in 6-month data reports along with summary tables and graphs. Hourly values are also stored on a tape supplied to the DMM-OS; see Table 9-10.

Regarding quality assurance for air data, daily zero-and span-checks are made to check for potential drifts. Monthly multipoint calibrations are made for all gaseous data. Third party quarterly audits (see discussion in Section 9.3.5) and data precision checks (see most recent data report) are part of the quality assurance program.

Water data are also incorporated into RAMIS, excepting streams data which are stored in the USGS WATSTOR data base, and interrogated by our computer dial-up. Values are then incorporated into the 6-month data report to the DMM-OS and put on tapes as indicated in Table 9-10.

Innovations on water data sampling techniques for deep wells instituted in May 1982 include the compressed gas driven samplers (Bar Cad System) for water quality, replacing swabbing, pumping and/or bailing and lineal, distributed-resistence water level sensors replacing conventional electric probes on electric reels. Such improvements also enhance the quality assurance aspects of the water quality program since the samples are much less

TABLE 9-10

Status of Automated Environmental Data Base

	Automated
Water Quality	
Springs and Seeps	October, 1974 thru November, 1981
Alluvial Wells	October, 1974 thru November, 1981
Deep Bedrock Wells	October, 1974 thru November, 1982
Wells Water Levels	
Water Levels	October, 1974 thru November, 1982
Water Augmentation Plan	
Springs and Seeps	July, 1979 thru October, 1982
Deep Bedrock Wells	August, 1979 thru October, 1982
Precipitation	January, 1979 thru April, 1982
National Pollutant Discharge Elimination System	
Water Quality Data	July, 1979 thru December, 1982
Water Usage	October, 1974 thru December, 1982
Well Reinjection	March, 1981 thru June, 1982
Air Quality	
Small Stations (Station AD42, AD56)	October, 1974 thru August, 1980
Large Trailer (Station AB20)	October, 1974 thru October, 1976 July 1978 thru January, 1982
Large Trailer (Station AB23)	October, 1974 thru December, 1982
Large Trailer (Station AB26)	October, 1981 thru March, 1982
Meteorological Tower (Station AA23)	October, 1974 thru December, 1982
Traffic	February, 1980 thru December, 1982
Biology	
Microclimate	October, 1974 thru December, 1982
Deer Kill	October, 1974 thru December, 1982
Deer Count	September, 1977 thru December, 1982
Avifauna	1977 thru 1981

Data collected and analyzed by USGS for stream flow and stream water quality are stored in government computer data bases in Reston, Virginia. These data bases (WATSTOR) and (NAWDEX) are accessed by dialing computer communications for retrievals of data to the Grand Junction computers for printing and analysis.

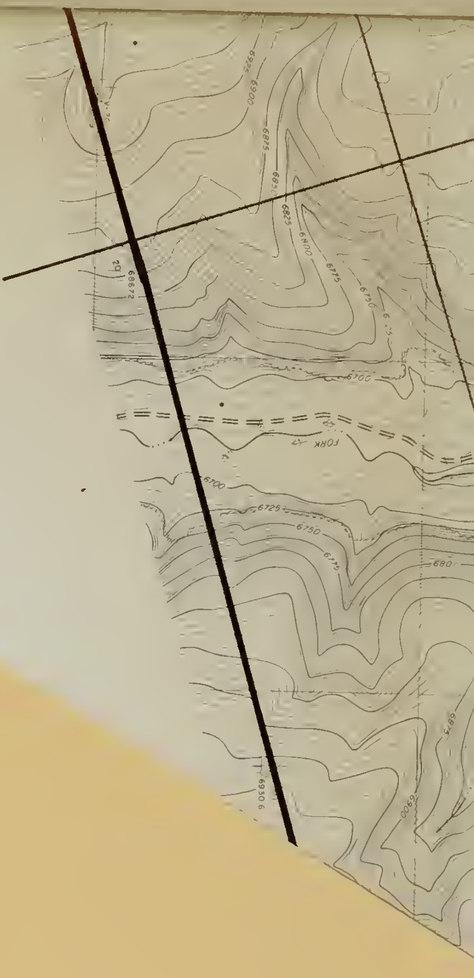
likely to be contaminated by pipe scale, joint lubricant and suspended solids attendant with the swabbing process. Additionally, the water quality data base is undergoing statistical examination for outliers.

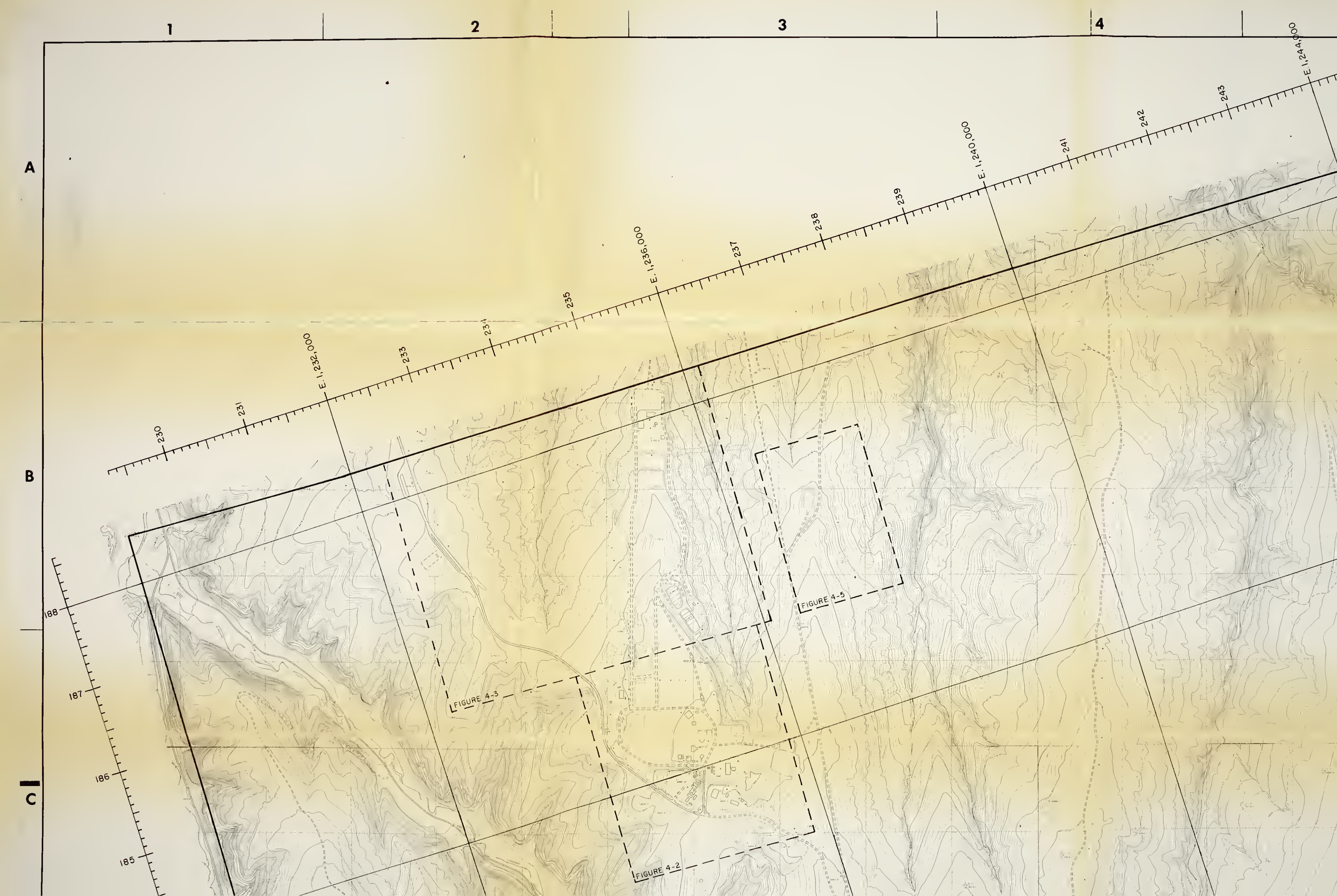
Quality assurance in the biological field program is achieved through sufficient replication, careful sampling techniques and third party professional guidance. To date microclimate, deer count, deer kill, and avifauna data have been automated on tape supplied to the DMM-OS.

9.3.15 Reporting

Annual reports are submitted to the DMM-OS during the anniversary month of the Lease (April). Semi-annual Data Reports are submitted on January 15 and July 15. Air quality data volumes in these reports are also submitted to EPA, Region VIII, and the Air Quality Control Division of the Colorado Department of Health. Hydrologic data have been forwarded to the USGS in Denver to provide additional inputs for the regional groundwater modeling development.

ROVALS





1
2
3
4
A
B
C
E. 1,232,000
E. 1,236,000
E. 1,240,000
E. 1,244,000
230
231
233
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235
237
238
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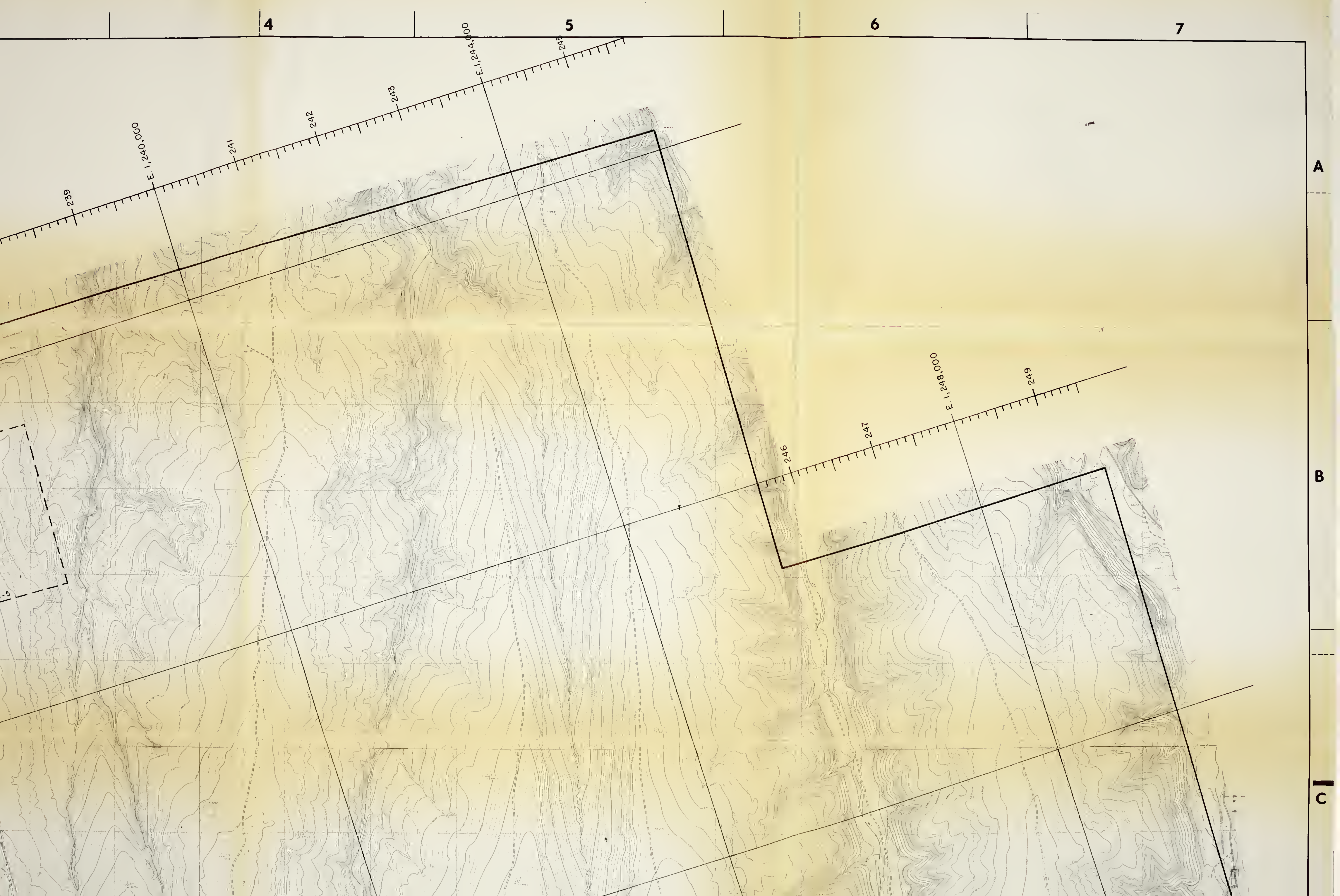
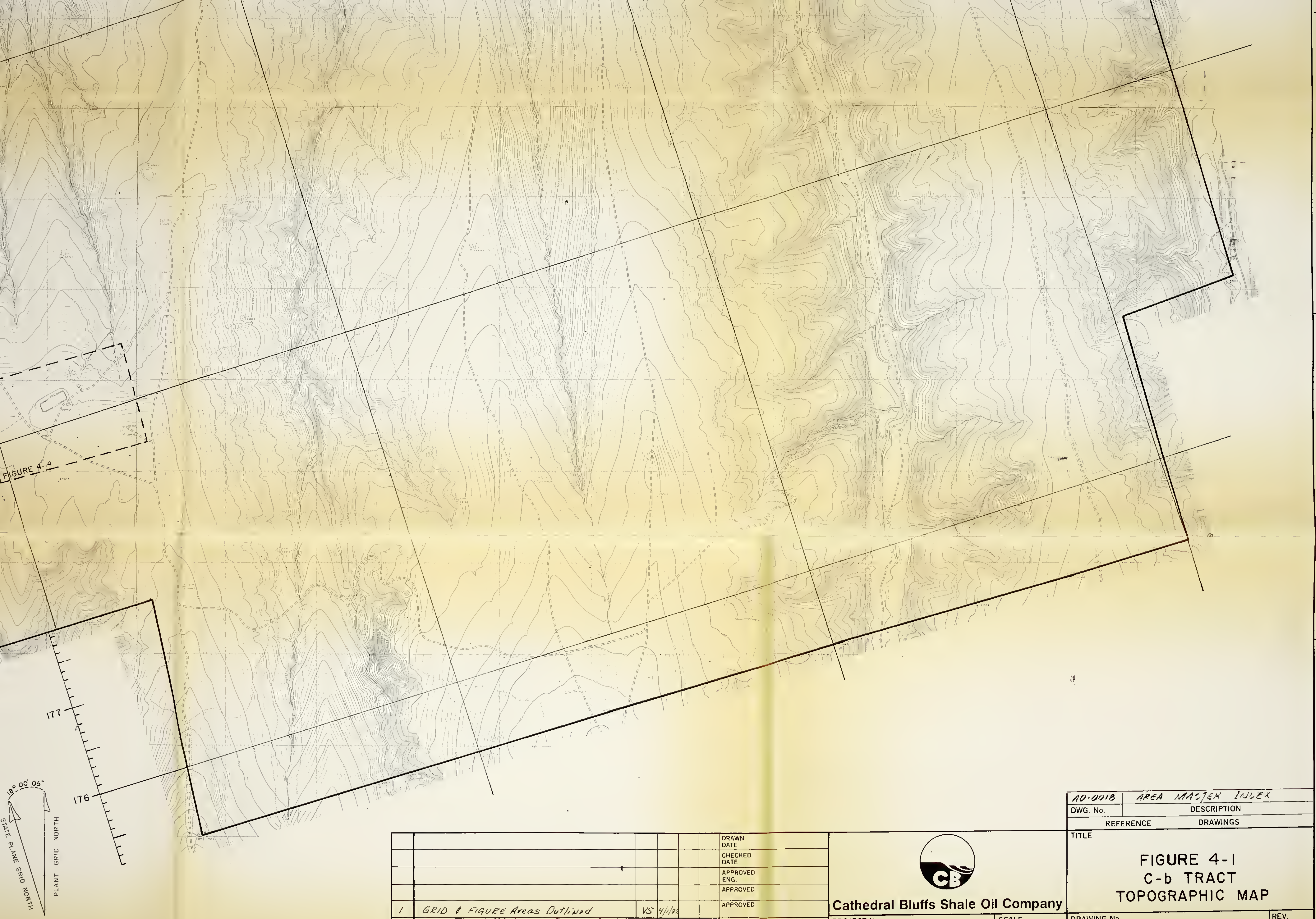
242
243
188
187
186
185
FIGURE 4-3
FIGURE 4-5
FIGURE 4-2



4
5
6
7
A
B
C
239
E. 1,240,000
241
242
243
E. 1,244,000
245
246
247
E. 1,248,000
249

FIGURE 4-3
FIGURE 4-2
FIGURE 4-4
C
D
E
187
186
185
184,000
183
182
181
180,000
179
178
177
176
18° 00' 05"
STATE PLANE GRID NORTH
PLANT GRID NORTH
SCALE 1" = 600'
600 0 600 1200 1800
THESE DRAWINGS WERE COMPILED USING AERIAL METHODS AND PHOTOGRAPHY TAKEN ON AUG.27, 1980.
GROUND SURVEY CONTROL BY CONSTRUCTION SURVEYS, INC. RIFLE, COLORADO.
PHOTOGRAMMETRIC SERVICES BY SCHARF AND ASSOCIATES, DENVER, COLORADO.
1/10
1/8 – 1/4
3/8 – 3/4
1/2 – 1



DWG. No.	DESCRIPTION
AD-0018	AREA MASTER INDEX

REFERENCE DRAWINGS

REV.	DESCRIPTION	DRAWN	DATE	CHK'D.	APPR.	APPROVALS
						DRAWN DATE
						CHECKED DATE
						APPROVED ENG.
						APPROVED
1	GRID & FIGURE Areas Outlined	VS	4/1/82			APPROVED

Cathedral Bluffs Shale Oil Company

PROJECT No. ESF-13.3

SCALE 1" = 600'

TITLE

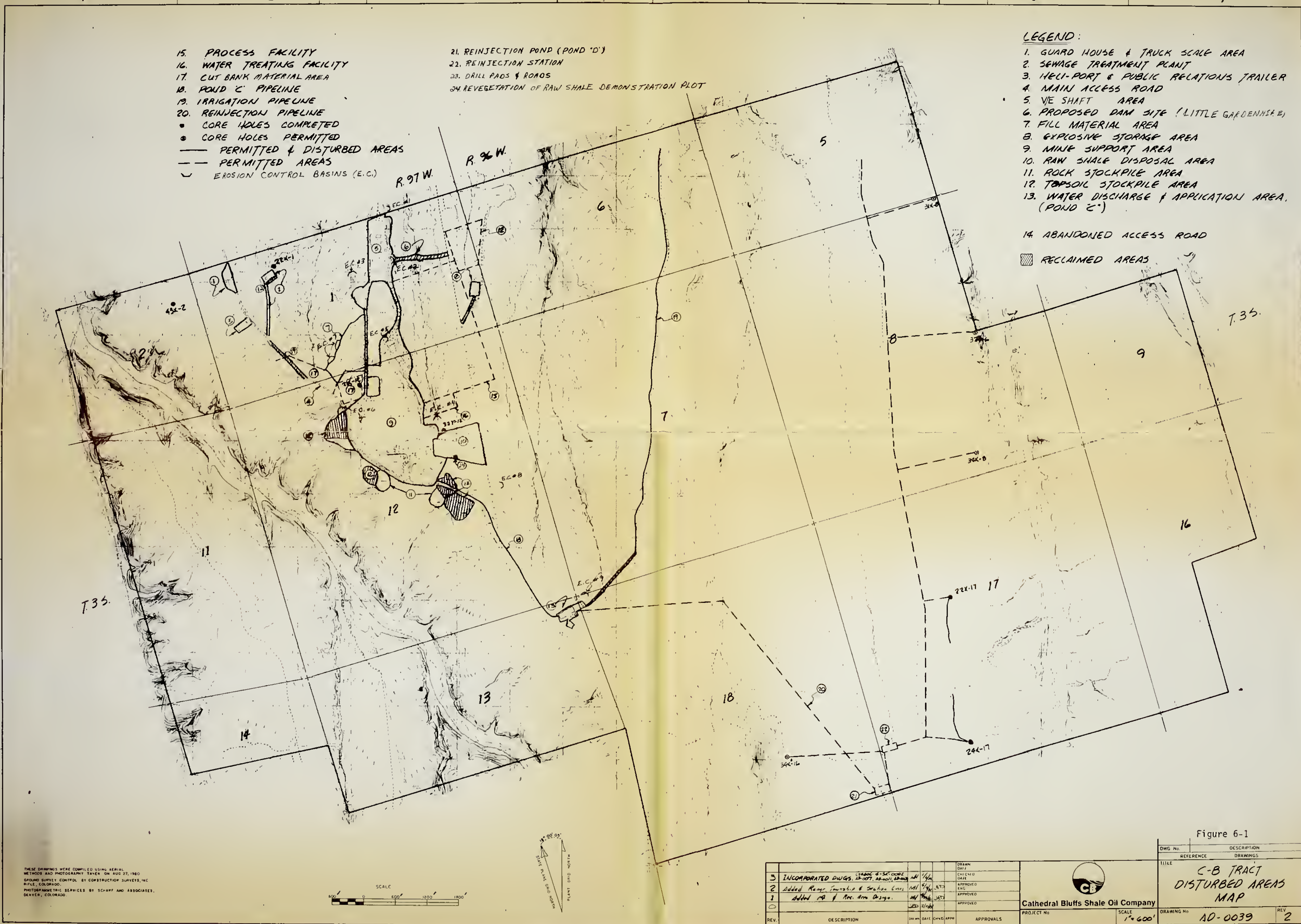
FIGURE 4-1
C-b TRACT
TOPOGRAPHIC MAP

DRAWING No. AD-0017

REV. P

½ — 1

FOLD



LEGEND:
1. GUARD HOUSE & TRUCK SCALE AREA
2. SEWAGE TREATMENT PLANT
3. HELI-PORT & PUBLIC RELATIONS TRAILER
4. MAIN ACCESS ROAD
5. V/E SHAFT AREA
6. PROPOSED DAM SITE (LITTLE GARDENHIRE)
7. FILL MATERIAL AREA
8. EXPLOSIVE STORAGE AREA
9. MINE SUPPORT AREA
10. RAW SHALE DISPOSAL AREA
11. ROCK STOCKPILE AREA
12. TOPSOIL STOCKPILE AREA
13. WATER DISCHARGE & APPLICATION AREA. (POND "C")
14. ABANDONED ACCESS ROAD
RECLAIMED AREAS
15. PROCESS FACILITY
16. WATER TREATING FACILITY
17. CUT BANK MATERIAL AREA
18. POND "C" PIPELINE
19. IRRIGATION PIPELINE
20. REINJECTION PIPELINE
CORE HOLES COMPLETED
CORE HOLES PERMITTED
PERMITTED & DISTURBED AREAS
PERMITTED AREAS
EROSION CONTROL BASINS (E.C.)
21. REINJECTION POND (POND "D")
22. REINJECTION STATION
23. DRILL PADS & ROADS
24 REVEGETATION OF RAW SHALE DEMONSTRATION PLOT
R. 97 W.
R. 96 W.
T. 3 S.
T. 3 S.
THESE DRAWINGS WERE COMPILED USING AERIAL METHODS AND PHOTOGRAPHY TAKEN ON AUG 27, 1980
GROUND SURVEY CONTROL BY CONSTRUCTION SURVEYS, INC RIFLE, COLORADO.
PHOTOGRAMMETRIC SERVICES BY SCHAFF AND ASSOCIATES, DENVER, COLORADO.
SCALE
3 INCORPORATED DWGS.
2 Added Range, Township & Section Lines
1 Added 19 & Rec. Area Design.
Cathedral Bluffs Shale Oil Company
C-B TRACT DISTURBED AREAS MAP
SCALE 1" = 600'
DRAWING No AD-0039
REV 2

Figure 6-1

DATE LOANED	BORROWER